



ANNALS OF SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE

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No. 1

ORIGINAL MEMOIRS.

OPERATIONS UPON THE HYPOPHYSIS.*

BY PROFESSOR DR. FREIH. V. EISELSBERG,
OF VIENNA, AUSTRIA.

RECENT investigations have demonstrated the fact that even to the smallest ductless glands must be ascribed a certain significance in the household of nature. Let me remind you of the importance of the thyroid and the parathyroid.

The hypophysis is also an important gland. In 1810, about one hundred years ago, Wenzel expressed the following opinion: "The appendix of the brain seems to play a more important rôle in the human body than one would be inclined to believe." The truth of this sentence has since been demonstrated by the investigations of our recent times, which proved that the extirpation of the hypophysis either kills the animal or injures it, and it seems that it is the extirpation of the anterior half of the gland which has the deleterious effect, because it seems to have some relation to the growth of the body, to the deposit of fat, and to the development of the genital organs. The hypophysis has also some correlative function to other ductless glands. The purpose of the posterior nervous portion of the hypophysis is hitherto unknown. I shall not enter into the discussion of the physiology of the hypophysis in this

*Read before the American Surgical Association, May 3, 1910.

paper, since Cushing has debated this point during the meeting of the American Medical Association at Atlantic City, and has added a great deal to this knowledge, showing (as he has told us during the International Congress in Budapest) that it is possible to produce a deposit of fat and a change of character of the animal by the extirpation of the anterior part.

Concerning the clinical experiences of the diseases of the hypophysis, it seems to be an established fact that a pathological increase of the function of the anterior portion of the hypophysis produces hyperpituitarism, that is, symptoms of giantism in infants, of acromegaly in adults; while a diminished function produces hypopituitarism, that is, a rapid deposit of fat in the subcutaneous tissue, a persistence of a juvenile type in younger individuals, and a decrease or loss of the genital functions in the adult.

To the first group of pathological conditions belongs the acromegaly described by Pierre Marie. It will be easily diagnosed in most cases, particularly when headache and disturbances of the optic nerve are present, and if the skiagraph is positive (as Oppenheim first demonstrated).

Besides acromegaly there is another type of disease, the adipose-genital degeneration, which has been explained as hypopituitarism. Though this type of disease has been seen before by different authors (Anderson, Schuster, Uhthoff), the first case which has been diagnosed and exactly described was observed in the outdoor department of Von Franckl-Hochwart, in Vienna, by Froehlich. The diagnosis is based upon general cerebral symptoms (headache, vomiting, epilepsy), upon changes of the optic nerve, and an adipose-genital degeneration, which means a regressive change of the breasts in women and a progressive change of this part in men, and anomalies of development of hair. Occasionally there are signs of abnormal temperature, drowsiness, and polyuria. While this observation has shown that there might be a great change of the hypophysis without causing acromegaly, post-mortem examination of patients with acromegaly has shown also the absence of macroscopic changes of the gland. Micro-

scopically, however, even in these cases a tumor has been demonstrated, as was proved lately by Erdheim.

The tumor may be a carcinoma (the hypophysis duct carcinoma of Erdheim) or a sarcoma, and finally, it may be mentioned that adenomatous and cystic tumors of benign character have been observed quite frequently.

Operative results of recent years have helped a great deal to clear up these questions. I could observe in two cases operated upon in 1907 a remarkable improvement of the complex of symptoms of hypopituitarism, and Hochenegg and Cushing had in their cases still more conclusive evidences of improvement of the acromegaly after partial removal of the tumor.

This leads me on to the treatment. The first operations on the hypophysis seem to have been performed by the brilliant English surgeon, Victor Horsley. Unfortunately I have been unable to get the details of his results. The question of the operative procedure in attacking the hypophysis has been studied on cadavers by Loewe (Berlin) and Koenig, Jr. (Altona), but has been cleared essentially by Schloffer (Innsbruck), who not only studied on a large number of cadavers the accessibility of the hypophysis, but also operated successfully in March, 1907, on a case, the first one on the continent (the patient survived the operation two and a half months). In July, 1907, I operated on my first, and in December of the same year on my second case, in both cases successfully, while a third case, operated also in December, 1907, for acromegaly, died of meningitis. In 1908 Hochenegg reported two successes. Cushing followed with one successful case, Kocher with one who survived the operation by four weeks. In addition we have to report a case of Hochenegg and one of Smoler, both of which died after the operation. In America, so far as I know, Cushing has had three, Halsted (Chicago) two, Mixter one.

So we can judge that the number of recorded cases is still quite a small one, and therefore I will give you, briefly, my own experiences.

I have operated altogether six cases, and will divide the

same in three groups. First, three cases of operations for typical hypopituitarism, all cured. Second, two cases of acromegaly, both died. Third, a combination of the first and second group, one case, considerably improved.

FIRST GROUP, HYPOPITUITARISM.

CASE I.—A man, aged twenty years, came to V. Franckl-Hochwart when eleven years of age, complaining of headache and vomiting. His intelligence and vision showed nothing abnormal. At the age of thirteen the patient grew considerably fat, and the vision of his left eye diminished. Later, also, the right eye grew dim. Examination showed a light amaurosis, right side, $\frac{1}{2}$ vision, temporal hemianopsy. Thyreoidin improved the condition temporarily, then followed a relapse, whereupon V. Franckl-Hochwart, who had kept him under observation for years, referred him to my clinic for operation.¹ On examining him, the infantile type was the most striking symptom. There was no hair on his body except on his scalp. His right eye showed atrophy of the temporal half of the papilla. The left eye genuine atrophy. The skiagraph showed an enlargement of the sella turcica. The processus clin. anteriores were visible, but the back was destroyed. These symptoms led us to the conclusion that a tumor of the hypophysis was present.

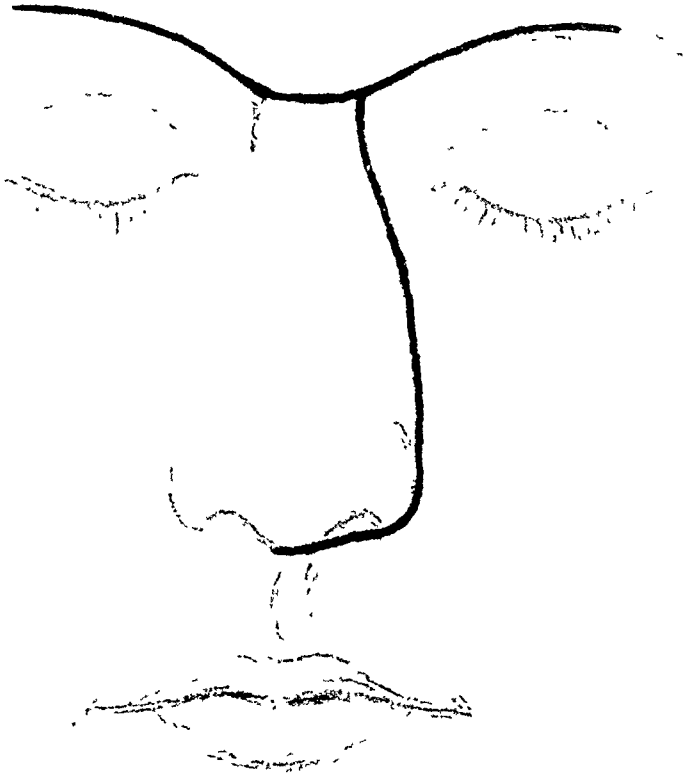
Operation June 21, 1907. Morphine-chloroform anæsthesia. An incision was made through the nose in the shape of a tuning fork, reflecting the nose to the right side, cutting through the septum, removing the turbinated bones, removing the anterior wall of the frontal sinus; these were the steps of the operation.

On account of a profuse hemorrhage the operation had to be continued in low head position. The vomer was removed, the anterior wall of the sphenoid excised, the sphenoid sinus opened, whereupon in the depth the prominence of the hypophysis became visible.² After carefully removing the thin covering of the dura I incised this membrane, and laid open the hypophysis in the exact

¹ Case reported extensively, *Neurol. Zentralbl.*, 1907, No. 21, "Operation on the Hypophysis by V. Eiselsberg and V. Franckl-Hochwart." Here cited only briefly.

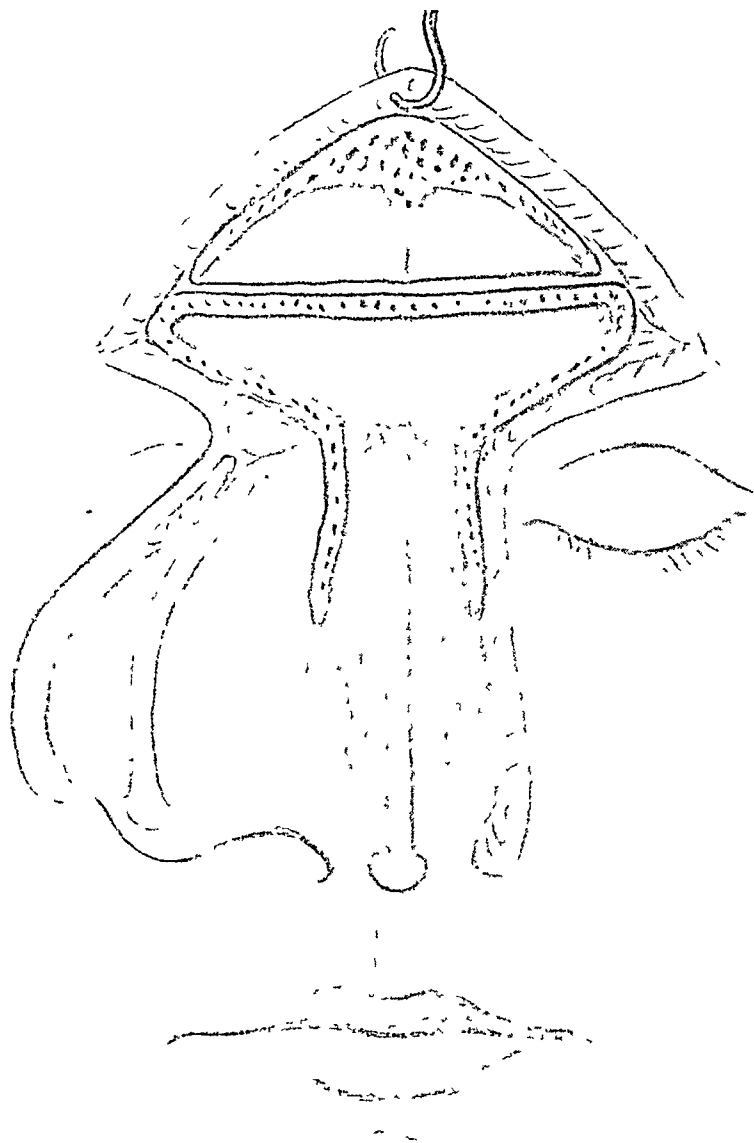
² I had studied the anatomical relations repeatedly with Prof. Tandler, who kindly assisted me, in his institute of anatomy in Vienna.

FIG. 1.

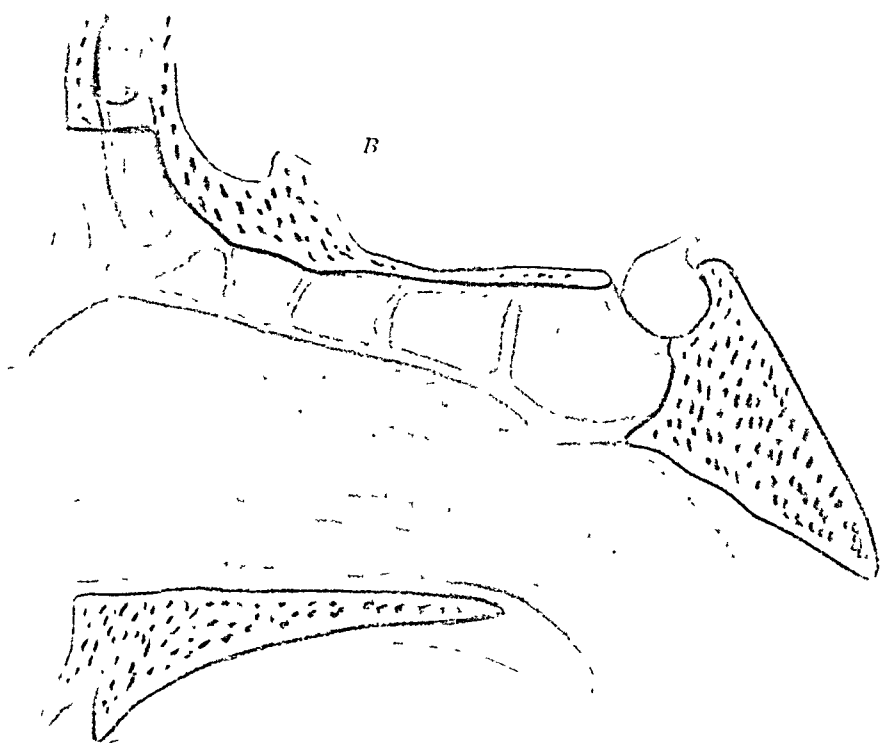
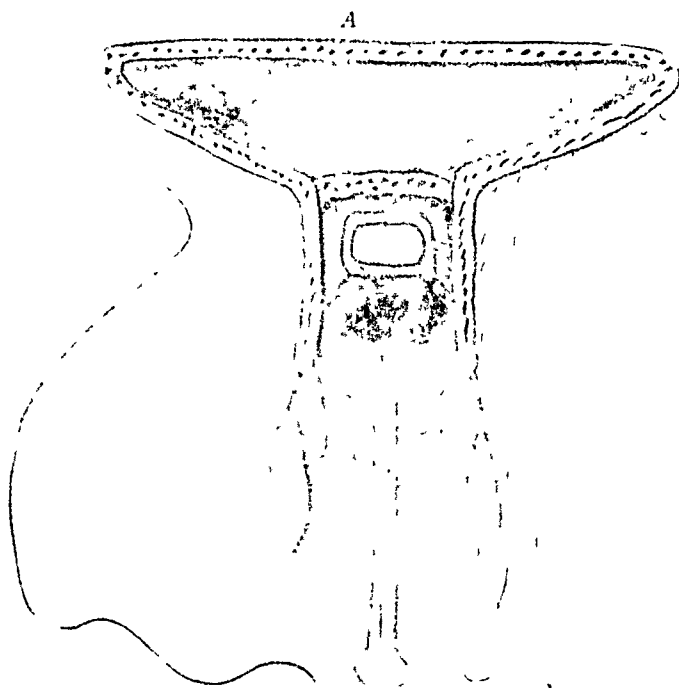


The operation on the hypophysis, lines of skin incision.

FIG. 2.



The operation on the hypophysis, the exposure of the roof of the superior fossa of the nose



relations of the hypophysis to the roof of the superior fossa of the nose. *A*, transverse section ;
B, anteroposterior section.

median line. A brownish-red fluid escaped and our scoop entered a larger cavity. At this moment we could see a distinct pulsation of the borders of the *dura mater*. Of these edges we removed particles for examination, and packed the cavity with isoform gauze. The skin incision was sutured carefully.

The patient made an uneventful recovery, with only a slight elevation of temperature in the evening.

The microscopic examination proved that the cyst had been formed by a tumor, which showed an infiltrating growth of truly epithelial character. Stoerck, of the Pathologic Anatomic Institute of Vienna, pronounced it an epithelial carcinoma, and thought it belonged to the more benign precancerous state. Whether it was formed in this locality or was a metastatic tumor could not be ascertained.

The symptomatic headache of the patient disappeared and his vision improved. He entered a sanatorium in the country where he remained under very favorable conditions for two months. It was remarkable that he lost two pounds under these conditions in the country, and particularly pleasant was the improvement of his vision. The temporal field of vision improved so much that the patient was able to go to the railroad station unassisted, and he could, after a time, resume his position as a clerk.

Two years and nine months after this operation we could establish that hair grew on his scrotum, that his general adiposity had decreased, and that his vision had remained continuously better.

CASE II.³—A man, aged twenty-seven years, a draftsman, always somewhat fleshy, has become considerably fat during the last few years. He complains of severe headache for the past three years, of double vision, and occasional vomiting for about a year. For the past few years a peculiar juvenile type is visible on the patient. His sexual appetite has disappeared entirely, and he has become gray haired rapidly of late. He is considerably fat; has no hair except on his scalp; his vision on the right side is such that he sees fingers at a distance of one metre. Bitemporal hemianopsy. The skiagraph reveals total absence of the sphenoid body and of sella turcica, and in its place is a large excavation.

³ See "Ueber einen neuen Fall von Hypophysis Operation bei Degeneratio-adiposo Genitalis," von V. Eiselsberg und V. Franckl, Wien. klin. Wochschr., 1908, Nr. 81.

Operation December 20, 1907, performed in the same manner as in the first case (according to the method of Schloffer). In exploring the hypophyseal tumor severe hemorrhage set in, which could be checked only by the use of small pledgets soaked with adrenalin. From the opening of the dura escaped a soft grayish mass, which could be scooped out and proved to be an angio-sarcoma.

The healing was very favorable. After six months the headache was gone, the vision improved to such a degree that patient could read large type.

In March, 1910, two years and three months after his operation, the patient wrote me a letter that he was doing remarkably well, that his vision had improved so much on the left side that he could read newspapers without difficulty. The field of vision, however, does not seem to be increased.

CASE III.⁴—A girl, aged eighteen years, has been suffering for the past two years from vomiting and headaches, and grew fat during this time. She consulted, on account of her vision, Dr. Bichowsky, in Warschau, who found a bitemporal hemianopsy. Right side, vision of one-third; on the left side she could only distinguish fingers. Skiagraph showed an absence of the sella turcica, anterior part. This led to the conclusion that he had to deal with a tumor of the hypophysis cerebri, and he referred the case to V. Franckl-Hochwart in Vienna.

The otherwise frail patient showed a remarkable development of fat, and there was no hair on her pubes. The examination revealed type adiposo-genitalis, a bitemporal hemianopsy, and the skiagraph showed a destruction of the entrance of the sella turcica, the basis of which seemed to be only slightly changed.

Operation December 12, 1908, nearly in the same manner as in the cases described before with the only exception that, following the advice of Hochenegg, we packed the nasopharyngeal cavity and opened the anterior wall of the frontal sinus temporarily. On account of the very narrow anatomical condition of the nose the operation was quite difficult. After removing the

⁴This case was mentioned by me during a discussion in the society of Vienna physicians, and also at the International Congress in Budapest. Later on published in *extenso* by Bichowsky (Warschau) under the title "Zur Therapie und Diagnose der Hypophysis," Deut. med. Wochenschr., 1909, Nr. 36.

hypophyseal prominence we found a cyst from which we removed about two teaspoonfuls of a chocolate-brown fluid.

The microscopic examination of these contents and a part of the cyst wall gave no evidence of malignancy.

The wound healing process was extremely complicated. For a week the patient seemed to be doing well. Then, after removal of a few strips of gauze, which we had put into a small posterior opening of the frontal sinus, a violent meningitis set in, the lumbar puncture revealed pure pus, consisting of many leucocytes and a mixture of bacteria, in which a good many streptococci could be recognized. The patient seemed to be lost. We injected, however, Paltauf's antistreptococcic serum, and into the veins electrol. In the meantime, however, the culture did not show streptococci, only a *Bacillus faecalis alcaligenes* developed. A few days later the patient improved. Another lumbar puncture yielded clear liquor. After two months the patient recovered permanently. The vision is remarkably improved. On the right side vision is two-thirds (before the operation one-third), left side, one-tenth (before the operation only movements of the fingers could be discerned). Two months after the operation patient menstruated for the first time, but the menses have not reappeared.

Now (March, 1910) she is absolutely normal, except that we find a temporal hemianopsy on the left side.

SECOND GROUP, ACROMEGALY.

CASE IV.⁵—Working woman, aged thirty-three years. Shows for the past eight years signs of typical acromegaly. During the last few months disturbances of vision and severe headaches set in. On admission to the hospital she shows the typical picture of acromegaly. Examination of the eyes yields bitemporal hemianopsy.

She is very anxious to be relieved of her intolerable headaches by a quick operation, which, is, however, postponed on account of a nasal catarrh, and she is sent home until this condition improves. After ten days, however, she returned and begged to be relieved of her headaches.

I am sorry I yielded, and undertook the operation December 17, 1907, in a manner described in the former operations. The

⁵ Case mentioned Wiener klin. Wochschr., 1908, 31.

removal of the tumor of the hypophysis brought forward grayish-red masses, which proved microscopically to be a sarcoma.

The same evening clear symptoms of meningitis set in, which led to an exitus in forty-eight hours.

Postmortem showed a basal sarcoma, extending clear up to the frontal lobes, from which a piece corresponding to the hypophysis has been extirpated. The case was from the start an inoperable one.

CASE V.—Woman, aged forty years; never had any children. Ten years ago she suffered from severe headaches, which improved after a duration of six months, whereupon a diplopia set in. Nine years ago she showed the first symptoms of acromegaly—insomnia, headaches, and disturbances of digestion. Arsenic and thyreoidin improved the condition only temporarily. For the past six months her condition grew worse, particularly the headaches.

On admission the patient exhibited the typical symptoms of acromegaly with the normal field of vision. On the right side there were some old corneal opacities, with a scotoma on the outside. The vision of the left side is, corresponding to the opaque condition of the cornea, one of an irregular astigmatism. The examination of the nose revealed a chronic catarrhal condition. The skiagraph shows an enormous dilatation of the sella turcica without destruction on the outlines. Very large sphenoidal sinus.

For a number of days the patient had received urotropin, as recommended by Cushing, before I operated on March 9, 1910, in the same manner as before.⁶ The operation was very simple, and completed in less than an hour. The dura was incised, and from the region of the hypophysis a tumor mass removed, which was carefully examined by Stoerck in the Pathological Institute of Vienna and pronounced parietal sarcoma, by Erdheim as carcinoma of the hypophysis.

Already the day after the operation headache and elevation of temperature appeared. A typical meningitis set in, which caused death after three days.

The postmortem showed recent suppurative meningitis (streptococci) on the basal surface as well as on the convexity of the brain. The largest portion of the tumor had been removed by the operation, only small particles were left on the operculum of the sella turcica. Some pneumonia in the lung.

⁶ Temporary opening of nose and sinus frontalis.

THIRD GROUP, MIXED TYPE.

CASE VI.⁷—Tinsmith, aged thirty-six years, married, father of healthy children; noticed five months ago that his left eye became weaker, and within three months he became blind on that side. At the same time he had intense headaches; the right eye also became worse in its vision. For the last year he had impotency. These symptoms and a skiagraph which showed a distinct enlargement of the sella turcica, with destruction of the outlines of the same, led Archibald Church, of Chicago, to diagnose a tumor of the hypophysis, and he advised an operation. Patient came at first into the clinic of Prof. Fuchs in Vienna with his eye trouble. Diagnosis of choked vision in both eyes and a clear, temporal hemianopsy on the right side was established, and the patient referred to my clinic.

He did not exhibit any apparent symptoms of acromegaly, but manifest deposit of fat in his subcutaneous tissue. The skiagraph was in accord with the diagnosis of Dr. Church.

January 16, 1909, the operation was performed in a similar manner as previously, and it proved more difficult than any other because the prominence of the hypophysis was hardly visible in the sphenoid sinus. The hypophysis itself was transformed into a large tumor which could be scooped out thoroughly.

The microscopic examination proved it to be epithelial carcinoma.

The course of the wound healing was normal, but the patient gave us a great deal of worry on account of his drowsiness, as it appeared to us as if he was suffering from an abscess, until finally these symptoms disappeared, and the patient could be transferred into the clinic of Professor Strümpell. He improved in a very short time, but his physicians noticed that his fingers and the anterior parts of his feet became visibly smaller. This was not only caused by the disappearance of his fat after the operation (he lost 20 kilos), but even his clothes which he had worn before his sickness seemed remarkably longer; for instance, his trousers were four centimetres too long, the foot three centimetres shorter, as

⁷This case is identical with Case IV in the article of Archibald Church, "Pituitary Tumor in its Surgical Relations," Jour. Amer. Med. Assoc., July 10, 1909.

his shoes, which had been fitting closely before the operation, proved by actual measurement. His gloves appeared a good deal larger around his wrist, and the fingers seemed about the width of of the finger shorter than before in the glove. The stiff hat of the patient falls down over his ears. His size of 39 centimetres is diminished by three centimetres.⁸

It seems to me important that the patient who has been impotent for two years has erections in the morning for the first time. The intelligence of the patient has improved, and of his drowsiness we cannot notice anything. His headache has disappeared. The least improvement is in the vision of the patient. His left eye has remained blind. His right eye has slightly improved, but the field of vision is still contracted. Patient left in March, 1910, for Chicago, where I saw him recently. He complained about rheumatic pains in his right shoulder.

I have as you see, operated six times on the hypophysis.

I can state, by the way, that I have seen a case of a boy shot in the head, where the bullet seemed to be lodged in the hypophysis. This is a year ago, and the child has shown no symptoms of dyspituitarism.

While in my first three cases of operation on the hypophysis an improvement of the symptoms of the adipose-genital type (disappearance of the obesity, reappearance of hair, reappearance of sexual function) was noticed. Both cases of acromegaly died shortly after the operation. Particularly interesting is Case VI, in which before the operation acromegaly was not manifest, but after the operation the remarkable decrease of circumference of the head, of the size of hands and feet, could be recorded. While this patient, notwithstanding his good nutrition, has lost 2 kilos, I must say that I believe it is a combination of both types. We can also imagine that through the growth of the tumor some parts of the anterior portion of the hypophysis were irritated, while other parts were destroyed. It is the question whether it would not be more rational to change the term of hyper- and hypopituitar-

⁸ I refer for the detail of these conditions, which appear so late after the operation, to the discussion of Dr. Stoerck, in Sitz. der Ges. f. Inner. Med., November, 1909.

ism into dyspituitarism. So far as the microscopic examination of my cases is concerned we found: twice (Cases I and VI) an epithelial carcinoma; twice (Cases II and IV) sarcoma; once (Case V) carcinoma or sarcoma; once (Case III) a cyst.

It is interesting, furthermore, that both cases of acromegaly exhibited a typical malignant growth. In one case it was so extensive that it involved the frontal lobe. The hypophysis which was removed during the operation was all transformed into a tumor mass. Also in my second case were signs of distinct malignant growth. In both cases, notwithstanding the positive presence of a malignant growth, symptoms of acromegaly were dating back for years, so that we had to conclude that these malignant tumors had grown remarkably slowly, a conclusion which seems to be hard to believe considering the malignant structure of the tumors. Altogether we find a remarkable discrepancy in the comparison of the postoperative course and the microscopic findings. We do not operate radically, even do not intend to do more than to diminish the size of the tumors, or remove the contents of a cyst, and nevertheless we notice such remarkable improvement which we are not accustomed to see in our operations on other parts of the body when we have done such an incomplete operation. We must draw conclusions from this that it is particularly the pressure which has been exerted by the tumor upon the remaining parts of the hypophysis, and which has produced the dystrophy (compare Hildebrand's case). But it is altogether remarkable that my first case, which was operated on almost three years ago, has shown a permanent improvement, and similar seems to be the course in Cases II and VI.

A few more remarks as to the technic of the operation. The hypophysis can be exposed by the intracranial route, or through the nasal or buccal cavities. The former method is by far the more difficult, because we have to exert some pressure upon the brain nerves, and we may injure one of the large vessels. Whether the method which Biedl and Karplus have employed in monkeys of late, in which the brain in Rose's position can be pressed forward half a centimetre, so that the

nerves are not injured, is also applicable for man, must be left an open question. At any rate, the intracranial route is heretofore regarded as the more difficult, the nasal route the easier, although it offers a greater danger of infection. We have to pass on our way to the hypophysis through a region saturated with microbes. It is well known that a simple cold immediately increases the virulence of a large number of micro-organisms, which are not innocuous for the meninges, and I could, to my sorrow, confirm this in my two cases (IV and V), particularly in Case IV, in which I gave in to the patient's demand to operate during a severe cold. Perhaps the chronic catarrh of the nose may be regarded as a constant companion of acromegaly. At any rate, we have to pay attention to catarrhal conditions in such cases. In my fifth case I think I made the mistake that I did not remove enough of the inferior turbinate, so that the cavity became very irregular and easily exposed to infection. In Case III the symptoms of meningitis set in with such a stormy manner, although we had found only a cyst. When my lumbar puncture produced pus in this case I had lost all hope for the patient. But fortunately the virulence seemed to have been a very low one, and the patient passed this danger. At any rate, we have to consider meningitis in the operation on the hypophysis, as I have had two deaths in six cases from this cause; that is by far a much larger percentage than we have in brain operations through the cranial cavity.

Only very few operators have attacked the hypophysis by the intracranial route (Horsley, McArthur, Krause, Borchartt). The majority of operators have used the nasal route. I followed in my operations essentially Schloffer's method. The method developed by Moskowitch, under the supervision of Tandler in the Anatomical Institute of Vienna, by which the anterior wall of the frontal sinus is definitely removed, and which was modified later and used successfully on a patient by Hochenegg, in a manner of a temporary resection, is already proposed in Schloffer's work on this subject. This temporary resection is cosmetically a great improvement.

The method which I followed in the last cases was as follows:

Prophylactic use of urotropin according to Cushing's suggestion, anæsthesia, packing of the nasal cavity (to prevent the operation in a dependent head position—Hochenegg), temporary resection of the nose and reflection to the right side, whereby the vomer is cut as far back as possible so as to prevent saddle-nose later on, temporary resection of the frontal sinus, total removal of the contents of the nasal cavity, including the posterior part of vomer and turbinated bone, exposure of the anterior wall of the sphenoid sinus, opening of the same, whereby the hypophysis prominence is laid bare. The lamp of Zeiss or a very good head mirror is absolutely necessary. The opening of the sella turcica must be made in the exact median line and not too much anteriorly, to prevent an injury of the carotids and the chiasma. After removal of the tumor or scooping out of the cyst⁹ we introduce drainage, pack the nasal cavity,¹⁰ and suture the skin exactly. The tendency of surgeons now is to perform this operation with least destruction of bones. Kocher¹¹ states, and it seems to me not unjustly, that the temporary resection of the anterior wall of the sinus frontalis is not necessary to lay bare the hypophysis.

Following the very good anatomical research from Kana-val,¹² the infranasal route for reaching the tumors of the pituitary body is proposed. Halsted, of Chicago, performed this operation twice (once with success). Mixter¹³ operated by reflecting the nose toward the front; the scar was scarcely to be seen. Hirsch (Vienna) removes the contents of the

⁹ We can hardly ever remove the entire hypophysis, as Cushing has shown by his animal experiments that after the most radical removal a thin veil of the anterior portion remains behind.

¹⁰ I shall use in the future, instead of the vioform or isoform gauze, the old iodoform gauze, which seems to have more disinfecting activity.

¹¹ *Deutsche Zeitschrift f. Chirurgie*, Band c.

¹² "The Removal of Tumors of the Pituitary Body by an Infranasal Route," *Journal of the American Medical Association*, November, 1909.

¹³ The cases of Halsted and Mixter were demonstrated at the meeting of the American Surgical Society, May 3, 1910.

nasal cavity in many sittings, and the same method seems to have been followed by West.

I had the pleasure of witnessing recently an hypophysis operation performed by Dr. Cushing, whose technic (similar to that of Kanaval and Halsted) impressed me so favorably—as it avoids as well any bone lesion as any incision of the skin—that I have decided to give it a trial on the next occasion. Still, I would mention that the scar in my last cases did not cause a too great deformity. It also seems to me that temporary resection, at least, of the nose, giving as it does a larger access to the field of operation, must in certain cases be of decided advantage.

We shall be able to achieve more in regard to vision only when the family physicians shall refer their cases earlier to the surgeon for operation. According to V. Franckl-Hochwart, the time of development of acromegaly, as he was able to glean from his observations of 124 cases, is a very long one, extending over many years, but the prognosis is only bad with regard to the vision. The operation must be regarded as a dangerous one as yet, but I believe that if we tell a patient that his malady continuously will get worse and finally lead to blindness, that he will rather submit to a very dangerous surgical procedure than to keep on doing nothing, and lingering into absolute helplessness.

TUMOR OF THE HYPOPHYSIS (WITH INFANTILISM).*

OPERATION—RECOVERY (PRELIMINARY REPORT).

BY SAMUEL J. MIXTER, M.D.,

AND

ALEX. QUACKENBOSS, M.D.,

OF BOSTON, MASS.

(Pathological Report by F. H. Verhoeff, M.D.)

ON the 12th of October, 1909, Charles A., twenty-seven years of age, born in Massachusetts, came to the Massachusetts Charitable Eye and Ear Infirmary for failing eyesight.

Family History.—His father is living and in good health, his mother has been dead a number of years. He is the youngest of five children, four of whom are living and well. One died of peritonitis. His brothers, three in number, are about his size, but heavier.

Previous History.—In childhood had the ordinary diseases, but never had diphtheria or scarlet fever. His growth was gradual, and he does not recall growing fast at any period, or that he has grown any during the past ten years. He thinks that the hair began to appear on his face and on his pubes at about the age of fourteen. He has never had to shave oftener than once a week. He gives his height as five feet six inches, and his usual weight as 130 pounds, although for the last year he has only weighed about 126 pounds. For the past five years his work has been in-doors, part of the time as elevator boy, the remainder as bell-boy.

He uses alcohol and tobacco, and thinks that his sexual powers are good.

Present Illness.—The present trouble possibly made itself manifest about five years ago; at that time he had headaches which he thought were due to eyestrain. Three years ago he had trouble with his eyes which was relieved by a glass. Six-

* Reported to the American Surgical Society, May 3, 1910.

teen months ago he had difficulty in using his eyes; from his story it sounds as if he had "diplopia," and he was told that he had "muscle trouble" and was given prisms. He now recalls that he had difficulty in seeing to either side at that time. About the same time he had an attack of rheumatism with stiffness in hips, knees, and ankles, but with no pain. Recovery was prompt under treatment. Six weeks ago he became head bell-boy, and this change required more use of his eyes, including some clerical work. He then noticed that his vision was blurred, and it soon failed so that he had to give up his position.

Physical Examination.—The patient is of medium size and has the appearance of a boy about eighteen, his face is smooth, fairly full, unlined, and asymmetrical. He has a peculiar pallor which would attract attention at once. The hair of the head is soft, thick and fine, that on his face is soft and scarcely shows on his chin, although he has not shaved for two weeks. His voice is not remarkable, certainly not feminine, although his speech is slow and moderate. Adam's apple not prominent. The skin upon the neck is smooth, white, and well padded. There is no hair upon the chest or in the axilla, and the pubic hair is rather thin and cut off horizontally at the pubes.

The teeth are normal and the hard palate high and narrow. The hands are rather large for his size, the fingers long, a little tapered, and spread at the tips. The penis is rather less than normal size, and the testicles are small. In shape the patient is rather womanly, especially upon a side view, the back is hollowed, and the hips are prominent. Heart, lungs and abdomen, negative. Urine normal.

Blood, 5,000,000 red, 18,000 white, hæmoglobin 70 per cent., blood-pressure low.

Eyes: The vision in the right eye is 8/200, in the left eye 6/200. There is bitemporal hemianopsia. The fundi show well-marked optic atrophy, the optic nerves are pale, sharply defined, and show no signs of a previous neuritis. The retinal arteries are rather small. The pupils react. The X-ray shows an enlargement of the sella turcica.

While under observation there was little change in the patient's condition, his vision remained about the same, his speech became a little slower, and there was a gradual loss of weight. At no time did he complain of headache. He is rather easily

FIG. 1.



Skiagraph of skull transverse view, showing relations of sella turcica

upset, on several occasions while being examined he became very pale and had an attack of diarrhœa.

The medical treatment consisted of strychnine sulph., Blaud's pills, and injections of citrate of iron. The hæmoglobin rose to 90 per cent.

OPERATION Dec. 27, 1909, by Dr. Mixter: Patient in dorsal position, posterior nares packed, and ether given with Fillebrown apparatus. The operation performed was that described by Dr. A. B. Kanaval (*Jour. A. M. A.*, vol. liii, p. 1704-1707). After making the U-shaped incision beneath the nose, the nasal processes were divided with a chisel and the nose forcibly turned upward and held by a stitch through the septum and forehead at the line of the hair. The mucous membrane was separated from the bony septum which was cut away, and with right-angled retractors a good view could be obtained of the upper part of the vomer where it is attached to the sphenoid. This was evulsed, opening the sphenoid cell. Up to this period there was fairly free hemorrhage, but packing with adrenalin gauze and the pressure of the retractors soon controlled it.

The sphenoidal cell was shallow, and on thrusting a blunt instrument through what appeared to be its posterior wall a gush of slightly turbid, cholesterin-laden fluid filled the field of operation. There was at least an ounce and a half of this fluid. The opening into the cyst (*sella turcica*) was enlarged with Mosher forceps, and the cavity was swabbed out with gauze, packed with a cigarette wick brought out through the nostril, and the wound closed. A gauze pack was placed in the other nostril to hold the septum in place.

An electric head light was used during the operation on the deeper parts, and during the last of the operation even the retractors could be removed without obstructing the view, so thoroughly had the mucous membrane and the turbinates been pressed back.

Recovery from the operation was rapid, although he had a slight erysipelas of the face.

The Kanaval operation was selected after numerous experiments on the cadaver and proved to be most satisfactory and simple. The distance from the lower part of the nasal opening is very slightly greater than from the upper part, and this is more than compensated for by its width, and the fact that

nothing but the vomer has to be removed in order to reach the sphenoidal cell, all other parts, including the turbinates, being easily held back with retractors. There was no bleeding into the mouth or throat and tracheotomy or the Roux position was unnecessary.

Postoperative History.—Following the operation there was a gradual improvement in sight, on January 23, 1910, the vision in the right eye was 20/30—, in the left eye 20/50+, the hemianopsia still persists. He was discharged from the hospital on February 15, 1910, with vision and fundi about the same as at last record. Following his discharge from the hospital he had an attack of rheumatism in his arms and legs, which lasted about six weeks, two of which he was confined to the bed. Under salicylate of soda this finally disappeared. On April 11, 1910, he reported that he was “feeling fine,” he had gained 20 pounds, and was able to read without any difficulty. His vision in the right eye was 20/30+, in the left eye 20/40+. Temporal hemianopsia. Examination of the fundi shows little change with the exception that the optic nerves may be of better color.

There is loss of sensation in the upper lip, and at times there is a slight watery discharge from the nose.

PATHOLOGICAL EXAMINATION by F. H. VERHOEFF, M.D. (From the Pathological Laboratory of the Massachusetts Charitable Eye and Ear Infirmary.)

The fluid submitted, 8 c.c. in amount, is odorless, slightly bloody, and contains an abundance of glistening particles. After sedimenting, it has the appearance and consistency of blood-serum. Under the microscope the glistening particles have the characteristic rhombic form of cholesterin crystals. There are a considerable number of red blood-corpuscles and a few white cells. Some of the cells are filled with fat droplets (not dissolved by acetic acid). Fat droplets are also found free in the fluid. Stained films from the gauze which had been rubbed into the cyst show a few pus cells and some epithelial cells. There is no broken down blood. The fluid does not undergo spontaneous coagulation, but is coagulated solidly by heat.

The tissue submitted for examination consists of a small piece of membrane, about 2.5 mm. x 2 mm. x 0.5 mm. in size, removed from the cyst wall on a swab. Before fixing in Zenker's fluid the membrane was spread out on a piece of paper so that exact cross sections could be made.

On microscopic examination the specimen is found to consist chiefly of epithelium. Within the epithelium there are numerous spaces, which as will be shown, are not glandular but stroma spaces. One surface of the epithelium has a smooth outline with occasional sharply defined

depressions, and is coated with serum. This is evidently a free surface which bounded a cyst cavity. The opposite surface is ragged and corresponds to the place of fracture in the removal of the specimen. The cells along the free surface are columnar in form, and at first glance might be mistaken for those of glandular or ciliated epithelium. Staining with Mallory's phosphotungstic acid hæmatoxylin, however, fails to show the fenestrated membrane characteristic of the latter, but does frequently bring out, running between the cells, intercellular fibrils of Herxheimer. Moreover, in places a distinct basement membrane may be made out as the immediate boundary of the cyst, which gives the reaction of collagen by Mallory's and Van Gieson's methods. The columnar cells along the cyst wall are, therefore, undoubtedly analogous to the basal cells of epidermis.

Below the surface, at different depths, the spaces are encountered. These are of various sizes, rounded or irregular in shape, the irregularities often being due to projections or infoldings of the epithelium into them. Around these spaces the epithelial cells almost invariably assume a columnar form. These columnar cells, just as those on the free surface, fail to show a fenestrated membrane and do show still more plainly intercellular fibrils and a basement membrane of connective tissue. Between the cells and this membrane definite fibroglia fibrils often occur. This columnar epithelium is therefore not glandular, but represents basal cells abutting on stroma. There are, in fact, no glandular lumina in the specimen.

Occasionally, owing apparently to the complication of its growth, whorl-like formations occur in the epithelium, but these never contain keratohyalin or other degeneration products. In places, especially near the free surface, definite prickle-cells occur. No mitotic figures are found after fairly prolonged search.

The stroma spaces contain connective tissue, blood-vessels, colloid material, and peculiar cells filled with globules. Most of them contain more or less of all these elements. In addition eosinophilic leucocytes are not infrequently encountered. Some of the spaces contain also serum, fibrin, and red blood-corpuscles, due probably to the trauma of the operation. A few of the spaces contain only delicate fibrillated connective tissue with a few stellate cells and single blood sinuses near the centres. In a few of the small spaces the stroma is uniformly hyaline. Other spaces are filled with globulated cells alone, and others still are apparently empty. The connective tissue is least where the globulated cells are most numerous, but the basement membranes persist after the rest of the stroma has disappeared. In some of the spaces where the globulated cells are abundant a new formation of connective tissue has occurred, the spaces here being pervaded by new formed fibroblasts accompanied by collagen and fibroglia fibrils.

The globulated cells each shows a round nucleus with one or two nucleoli, while its cytoplasm is usually entirely replaced by large globules of fairly uniform size. The globules are situated in a cell reticulum which stains in acid fuchsin. The globules themselves fail to stain in any

of the usual stains, but retain a more or less decided yellow color, which they show in unstained specimens. Some of these cells packed with globules reach comparatively enormous proportions. In these the nucleus is pycnotic or is absent. Suitable stains show in the cells with only one or two globules, or similar cells free from globules, centrosomes contiguous with the nucleus.

Careful study of the specimens shows occasionally these globules and reticulum in an epithelial cell bordering on a space. These cells are never much enlarged, and the globules do not replace the cytoplasm entirely. In no instance can one of these cells be found in the act of entering or discharging its contents into a stroma space. In one situation proliferation of flat cells lying along and internal to the basement membrane can be made out. Whether these are epithelial or endothelial cells it is impossible to determine.

The colloid material occurs in the stroma spaces usually as rounded masses. Often they completely fill the space so that they are closely surrounded by epithelium. It does not seem that the colloid material is ever directly formed by the epithelium, however. In some places where the colloid bodies are massed together, the epithelium has grown in between them from the periphery. Occasionally one of the bodies is surrounded by a foreign body giant cell. The colloid material, apparently according to age, stains from pink to dark blue in hæmatoxylin-eosin, reddish to blue in Mallory's connective-tissue stain, and yellow to red in Van Gieson's stain. Some of it has evidently undergone calcification. Under the high power it appears finely granular and sometimes shows concentric lamination. It appears identical with the colloid excrescences of the pigment epithelium of the retina. Occasionally some of the yellow globules above described, and degenerated cell nuclei, are found within them, indicating that they are formed from the globulated cells.

DIAGNOSIS: Congenital epithelial tumor of hypophysis cerebri with cystoid degeneration.

REMARKS.—It is certain that the fluid examined represented the contents of a large cyst from the facts that it was loaded with cholesterin crystals, that it had the appearance and consistency of serum, was coagulable by heat, and that it contained epithelial cells. It is almost equally certain that the piece of solid tumor tissue removed formed part of the immediate wall of the cyst because of the smooth uninjured surface presented by one side of it. For this reason, as well as for those already given, it is clear that the cyst was not glandular in nature but a dilated stroma space in which the stroma had degenerated and disappeared. That the tumor was derived either from the hypophysis in embryo life, or from some congenital anlage having the potentiality of an hypophysis, is indicated by its situation,

its epithelial nature, and its structure. In structure it shows a remote similarity to the invaginated epithelium of the buccal epithelium forming the embryo hypophysis, and its origin from buccal epithelium is further indicated by the occurrence of prickle-cells in places.

Another strong argument in favor of the tumor being an analogue of the hypophysis is that in this situation in the embryo there is no other epithelial invagination which occurs. The only other congenital epithelial tumor which might reasonably be expected to occur here, aside from true teratomata which may occur anywhere, is the chordoma. The notochord, however, never contains epithelium similar to that in this tumor—the resemblance of its tissue to epithelium is always remote. It never shows basal columnar cells nor prickle-cells.

The nature of the globulated cells in the stroma of this tumor is not clear. I have failed to find similar cells in either the adult or embryo hypophysis. The round cells containing them are similar to endothelial cells, yet the fact that the globules may be found in epithelial cells abutting on the stroma suggests that the globulated cells in the stroma spaces are of epithelial origin.

The histological structure of the tumor seems to show a certain analogy to that of the congenital tumors of the salivary and lachrymal glands known usually as mixed tumors, especially to those presenting a cylindromatous structure. For here, just as in a cylindroma, there are stroma spaces bordered by basement membranes of connective tissue and fibroglia, in which the stroma shows various stages of degeneration. The character of the degenerative change is in general different from that in a cylindroma, but this is no doubt due to a different embryonic relationship. Nevertheless, some of the spaces show a typical hyaline change. The fact that the epithelium contains epithelial fibrils and prickle-cells is no doubt due to its origin from buccal epithelium. Here again there is an analogy to a cylindroma, for as I have shown elsewhere,¹ the latter tumor may produce these structures also. In some cylindromata I was able to demonstrate minute glandular lumina in the epithelium around the stroma spaces, but these are absent in this tumor.

¹ "The Mixed Tumors of the Lachrymal and Salivary Glands," *Journal of Medical Research*, Feb., 1905, p. 319.

The question whether the tumor was actually connected with the adult hypophysis is relatively unimportant. It may have arisen from a separate infolding of the embryonic buccal epithelium. Such an origin would be analogous to that of many tumors of the lachrymal gland which arise, not from the normal gland, but in close proximity to it.

If the above interpretation of this tumor is correct, such tumors should not be classed with the teratomata, but with the more simple epithelial or mixed tumors of congenital origin. Since a suitable term which includes this whole group of tumors is apparently lacking, I would suggest the term *congenital epitheliomata*. This term emphasizes their two most important features, namely, their congenital origin and their essentially epithelial nature. As I have pointed out elsewhere, even when these tumors consist chiefly of cartilage they are yet essentially epithelial so far as their origin is concerned.²

The prognosis for this group of tumors and therefore presumably for the present tumor is favorable as regards the likelihood of metastases, but unfavorable as regards local recurrence or increased growth after operative interference. In this particular case, however, the tumor was not greatly traumatized, so that it may retain its previous inactivity.

²In the Journal of the American Medical Association, Sept. 25, 1909, Dr. Hecht has reported a tumor of the hypophysis pathologically examined by Dr. Herzog, sections of which they have kindly sent me. This tumor in certain details shows little similarity to ours, yet in all probability it is essentially of the same nature and also belongs, as Dr. Herzog contends, to the simple mixed tumors that I would call congenital epitheliomata. It shows one remarkable and striking feature which I would interpret differently from Dr. Herzog. By rather abrupt transition the basal columnar cells of the epithelium become converted into a network of stellate cells with communicating processes, thus forming a syncytium. Dr. Herzog describes this as connective tissue. This syncytium appears identical with that of a developing tooth or adamantinoma. The embryonic notochord also shows a similar syncytium, but the tumor in no other way suggests a chordoma. Dr. Herzog states that this tumor contains no neuroglia, but in the specimens sent me I am sure that the stroma consists almost entirely of neuroglia similar in appearance to the *pars nervosa* of the adult hypophysis. In the Van Gieson specimen this tissue gives the yellow staining reaction of neuroglia, in contrast to the pink stain of the tissue accompanying the blood-vessels.

CLINICAL EXPERIENCES WITH INTRATRACHEAL INSUFFLATION (MELTZER), WITH REMARKS UPON THE VALUE OF THE METHOD FOR THORACIC SURGERY.*

BY CHARLES A. ELSBERG, M.D.,
OF NEW YORK.

DURING the past year Meltzer and Auer¹ have described a method of artificial respiration which they call "respiration by the continuous intratracheal insufflation of air." A small tube was passed through the larynx into the trachea almost to the bifurcation, and by means of a foot-bellows air mixed with ether was blown almost continuously through the tube under a pressure of 15 to 20 mm. of mercury. By this means the lungs remained distended, the excess of air passing upwards in the trachea and out through the larynx and mouth in an almost continuous stream. One or both pleural cavities could be widely opened and the animals could be kept alive for many hours. The animals remained alive and in good condition even when deeply under the effects of curare so that all respiratory movements were abolished. In later publications Meltzer has described the method in detail, and has expressed the hope that intratracheal insufflation might prove to be of value for intrathoracic operations in the human being. A large number of experiments on dogs were made by Meltzer and Auer,² and many operations upon the intrathoracic viscera were performed by Carrel,² and by the writer. These showed conclusively that the method of intratracheal insufflation was a very efficient one for intrathoracic operations in animals.

The negative and positive pressure methods of Sauerbruch and of Brauer were first tested on animals, and because they were shown to make intrathoracic operations in animals possible through the avoidance of collapse of the lung, they were

* Read before the New York Surgical Society, May 11, 1910.

recommended in the human being. The method of intratracheal insufflation is so very simple, that if it should be proven to be as efficient in operations in man as it has been shown to be in animals, it would be a method of the greatest value in thoracic surgery in the human being.

In a previous paper³ the writer has considered in detail the advantages and disadvantages of intratracheal insufflation in man and has described an apparatus for use in the human being. At the time the paper referred to was written, we had not yet had any experiences in patients, and therefore the suggestion that the method of Meltzer should be tried in human surgery was based on the results of animal experiments and upon theoretical considerations. During the past few months we have used intratracheal insufflation in several patients, and the results have been very satisfactory.

From the experiences we have had I would suggest the following technic for the introduction of the intratracheal tube:

The tube that is to be introduced into the trachea should be a fairly rigid one of rubber with an opening at its lower end. It should be about as long as an ordinary stomach tube. Tubes of various sizes should be kept on hand. The tube to be used in a given case should fill up about one-half of the lumen of the trachea. One can obtain a sufficiently accurate idea of the size to be used by estimating the diameter of the trachea at the root of the neck.

The patient is first anæsthetized in the usual manner and the larynx and pharynx then thoroughly anæsthetized with 10 per cent. cocaine solution. In some patients the introduction of the tube can be accomplished by pulling forward the epiglottis with the index finger of the left hand, and introducing the tube into the rima glottidis with the right hand or with a laryngeal forceps. In the large majority of cases it may be preferable to expose the larynx with an appropriate speculum, such as the Killian or Jackson instrument used in bronchoscopy, and then to introduce the tube with the larynx in full view.

When the sterilized tube has passed the vocal cords it is

pushed forward slowly until a slight resistance is felt—the bifurcation of the trachea. No resistance may be felt until the tube reaches the division of the right bronchus. If the tube is correctly placed, air can be heard to enter both lungs upon auscultation. The tube is then withdrawn about one inch so that its lower end will lie a short distance above the bifurcation. The sound of the air as it passes up and down the tube on expiration and inspiration is a proof that the tube has been properly introduced into the trachea. I have devised a special mouth-bit by means of which the tube is kept in place and against the upper teeth. The mouth can be freely opened so that the buccal cavity can be sponged out, a stomach tube introduced into the stomach if desired, etc.

The tube is now connected with the air-pressure apparatus, and air is blown through at a pressure of 10 mm. of mercury. After several minutes, the pressure is raised to 20 mm. and the operation can be begun.

When the pressure of the inflowing air and ether equals 20 mm. of mercury, inspiration and expiration will continue, air being inhaled and exhaled by the side of the tube. If there existed a profuse secretion of mucus in the pharynx and trachea, this will be found to have ceased soon after the insufflation was begun. Every two to three minutes, an assistant opens a vent so that the current of air which enters the tube is interrupted for a moment.

Two assistants are required to manage the apparatus and the anæsthesia,—one controls the pressure by the manometer and interrupts the stream every few minutes, the other manages the anæsthesia and watches the patient's general condition.

For a full description of the apparatus required, the reader is referred to a previous paper.⁴ The apparatus I have devised has been used by me for the intratracheal insufflation in the following cases:

On December 9, 1909, a young woman of thirty-four was admitted to the Mt. Sinai Hospital with advanced symptoms of myasthenia gravis. On the 25th, the patient stopped breathing for several minutes but respiratory movements returned again.

During the following night respiration suddenly ceased, the patient became deeply cyanosed, and asphyxia and death seemed imminent.

The insufflation apparatus had been kept in readiness at the patient's bedside. When I reached her she was unconscious, very deeply cyanosed, pulseless. Without trouble, the mouth was opened, the epiglottis drawn forward with the index finger of the left hand, and the tube passed through the glottis down into the trachea. A mixture of air and oxygen was then passed into the trachea under a pressure of 20 mm.

Within one minute, the appearance of the patient was completely changed; the face became pink, all cyanosis disappeared, the pulse could again be felt at the wrist. The pulse-rate was at first very slow—32 to the minute—but it soon became of good quality and more rapid—110 to 120.

For about five hours the intratracheal insufflation was continued and during this time the patient did not make a single respiratory movement. Her color, however, remained good, and her pulse of good quality. Finally the insufflation was stopped as the condition was a hopeless one.

This observation—which can be likened to the experiments in which curarized animals were kept alive for a number of hours—demonstrated the efficiency of the method for artificial respiration. Intratracheal insufflation should be of value in the treatment of asphyxia of many kinds—chloroform asphyxia, opium poisoning, asphyxia neonatorum, etc.

The following is the first case of an intrathoracic operation performed under anæsthesia by intratracheal insufflation:*

Abscess of the Lung; Thoracotomy and Aspiration of the Lung under Intratracheal Insufflation. Recovery.

B. F., a butcher, fifty-five years of age, was referred to the II Surgical Service by Dr. Manges with the diagnosis of an abscess of the middle lobe of the right lung.

February 14: The patient was anæsthetized with ether, and the attempt was made to introduce a small catheter into the trachea. The patient took the ether very badly, and I did not have on hand

* The full details of this case will be published by Dr. Lilienthal.

the proper kind of tube nor the necessary instruments for the intubation. After a number of unsuccessful attempts to pass a catheter through the larynx we determined to put off the intubation until a later time. The operator (Dr. Lilienthal) then resected four inches of the eighth and ninth ribs and packed the wound cavity with gauze.

February 20: Operation by Dr. Lilienthal, intratracheal insufflation by Dr. Elsberg. Ether anæsthesia; larynx and pharynx thoroughly anæsthetized with cocaine. A soft rubber tube, No. 28 French scale, was passed through the glottis by means of a laryngeal forceps and pushed downward until a slight resistance was encountered. The tube was then fixed to the upper teeth by means of a gag. The tube was connected with the insufflation apparatus and a mixture of air and ether blown in under a pressure of 15 mm. of mercury. The patient began to cough violently, therefore the intratracheal tube was withdrawn about one inch. The coughing ceased at once, and at the same time all evidences of mucus in the trachea or pharynx disappeared. The patient's color was good, respirations regular, pulse of good quality. The patient was now turned on the left side and the operation begun.

3.10—No cyanosis, pulse 120; incision 12 cm. in length into right pleural cavity; pulse unchanged, color good, no cough. Pressure of current now raised to 20 mm. Palpation of the lobes of the right lung.

3.20—Pulse 108; respirations 48; color good with slight cyanosis; pleural cavity is wide open.

3.25—Heart action excellent; pulse 96; color good, no cyanosis; aspiration of middle lobe of lung.

3.30—Pulse 105; respirations 42; color good.

3.35—Pulse 108; respirations regular, 40. The current of air is interrupted several times in order to observe the appearance of the lung. When the current is prevented from entering the intratracheal tube the lung collapses and is of a dark green mottled color; when the lung is markedly distended (25 mm. pressure) the lung is of a bluish color with areas of red. When the lung is collapsed the œsophagus and aorta can be seen and examined.

3.40—Suture of incision in pleura. While the last stitches are being passed the pressure is raised to 30 millimetres in order to slightly overdistend the lung so that as little air as possible shall remain in the pleural cavity.

3.45—Pleura closed with small drain; pulse 132 and of good quality.

3.50—Color good, no cyanosis; respirations 32.

3.55—Suture of muscles and skin; voluminous dressing. The intratracheal tube is withdrawn. Pulse now 120, of good quality; respirations regular, no cyanosis.

Four minutes after the patient was taken to his bed he was awake. He said that he did not have any pain in his larynx; he was not hoarse. The morning after the operation the patient was in very good condition. He complained of some pain in the right chest and had considerable mucopurulent expectoration. He was not hoarse and did not complain of any pain in his laryngeal region. The auscultation of the right side of the chest through the bandages was not satisfactory, but breathing sounds could be heard over the entire side.

From this time on the patient steadily improved, the cough and expectoration grew less daily; he was out of bed on March 10 and was discharged from the hospital with his wound almost healed on March 25. When last seen (April 22) he was in excellent condition; the breathing sounds over the right side of the chest seemed normal; he had almost no cough and practically no expectoration; he had gained considerable flesh and strength.

From the stand-point of the intratracheal insufflation, the operation was highly successful. The lung abscess could not be found at the operation. This was probably due to the fact that the patient had coughed up a large quantity of pus just before he was brought to the operating room. It is of exceeding interest, also, that almost all of the symptoms from which the patient had suffered for nine months, have disappeared. No good explanation for the gratifying result of the operation can be given. The resection of ribs, the pneumothorax, and possibly the insufflation itself might have contributed to this end.

The patient took the anæsthesia exceedingly well; only a small quantity of anæsthetic was required, and the contrast between the anæsthesia given in the ordinary manner and that given by intratracheal insufflation was very marked. As soon as the insufflation was begun, the patient who had been strug-

gling and coughing, his pharynx filled with mucus, became quiet, and the rattling of mucus in the trachea and pharynx disappeared. The patient recovered consciousness unusually quickly.

In order to test the method further, intratracheal insufflation anæsthesia was tried in the following case:

In a patient with an empyema of the right chest, a tube was passed into the larynx and trachea after the patient had been anæsthetized with ether and the larynx cocainized. Intratracheal insufflation anæsthesia was then begun with the apparatus and the operation—which consisted of resection of a rib and opening and drainage of the pleural cavity—was done without difficulty. The anæsthesia was very satisfactory; very little ether was required; the patient's color and his pulse remained good. There were no after effects from the insufflation.

The experiences we have had with intratracheal insufflation have demonstrated that the results obtained by Meltzer and Auer, by Carrel, and by myself, in our animal experiments, can also be obtained in the human being. A much larger experience is necessary before any definite statements can be made. There is every reason, however, for a thorough trial of the method. Meltzer's method of intratracheal insufflation recommends itself by its very great simplicity. If the future will show that it is as safe for the human being as it is for the animal—and our experiences seem to point in that direction—then surgery will have a very simple method for the prevention of the dangers from acute pneumothorax, a danger which has been the chief hindrance to the development of intrathoracic surgery.

REFERENCES.

¹ Jour. of Experimental Medicine, 1909, No. 4, see also 2.

² Medical Record, March 19, 1910.

³ Medical Record, March 19, 1910.

⁴ *Loc. cit.*

THE FIRST CASE OF THORACOTOMY IN A HUMAN BEING UNDER ANÆSTHESIA BY INTRA- TRACHEAL INSUFFLATION.*

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OF NEW YORK,

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B.F., a butcher, 55 years old, had been under observation by Dr. Manges since September, 1909. At that time he gave a history of an illness of nine months, which began three weeks after he had cut and infected his finger while slaughtering a cow whose lungs and intestines, he said, were "studded with white granules the size of a barley-corn." The infection was severe and accompanied by a chill and fever. The finger was incised, following which the constitutional symptoms disappeared, and the wound healed slowly, taking three months before it was entirely closed. His illness dated, then, three weeks from the onset of this infection, at which time he noticed that his breath was foul, that he was continually nauseated, and that he was coughing a good deal. About a month later he had a severe chill followed by fever, and the same day coughed up about a quart of very foul, greenish pus. This relieved him for a time, although he continued to cough and to bring up quantities of pus, especially in the morning. A second febrile attack came on in September, 1909, when he coughed up a large quantity of blood. It was then that he was admitted to Dr. Manges's service at Mt. Sinai Hospital, where he remained three weeks and left much improved. The improvement was only temporary, however, for he was able to work only a month before he was again taken ill in the same manner. From that time his history was a repetition of the symptoms previously outlined, and the patient again applied to the hospital for relief. On February 10, 1910, he was again admitted, after Dr. Manges had referred him to me, this time to the Second Surgical Service.

* Read before the meeting of the New York Surgical Society, May 11, 1910.

His general nutrition and color were good. He was a thick-set, short-necked man, with a barrel-shaped chest, which showed fair and equal expansion on both sides. The percussion note was somewhat impaired over both lungs, with slight dulness in the right axilla and at the right base, posteriorly. The breathing at the right base was somewhat exaggerated. Soft râles were heard scattered over the entire right chest. Vocal resonance and fremitus were not impaired and were equal on both sides. There was marked clubbing of the fingers. Temperature was normal; pulse 80 to 90. The patient was expectorating foul, greenish pus. No tubercle bacilli could be found although the Von Pirquet reaction was positive in twelve hours.

An X-ray plate showed a shadow of moderate density in the outer portion of the right side of the chest, between the first and third ribs anteriorly. There was calcification of the cartilage of the first rib, and apparently some infiltration of the mediastinal glands.

A diagnosis of lung abscess had been made, and now the possibility of a radical cure of this patient was suggested by the excellent results obtained in the animal experiments with Elsberg's modification of the Meltzer-Auer apparatus. The first attempt to use this method was unsuccessful because of the failure to introduce the tube into the trachea. This failure was due to a short, thick neck and a very irritable larynx, which could not be made tolerant even by a large dose of morphine and both ether and chloroform by drop method. Fearing to prolong unduly the attempt to introduce the tube, the drop anæsthesia was continued, and a broad resection of the eighth and ninth ribs, in the posterior axillary line, rapidly made without opening the pleura. There were no untoward symptoms following this operation. A very slight postoperative rise in the temperature (99.8°) took place and lasted for two days. By February 21 I considered that the patient was in condition for a second venture.

At this time the preliminary anæsthesia was as trying and unpleasant as before, but an application of 10 per cent. cocaine to the larynx and pharynx made it possible, with some difficulty, to pass the tube. The details of the anæsthesia and workings of the apparatus belong to Dr. Elsberg. It is sufficient to note here that the patient was easily kept in narcosis with a small

amount of ether and that the respiration was unimpeded by mucus, although this had been troublesome during the preliminary anæsthesia. The breathing was regular and extremely deep, except when the lungs were fully distended, when there was a moment of apnœa. The patient's color remained good throughout the operation and the pulse of excellent quality, varying between 108 and 132.

As to the operation itself: The wound was cleansed with peroxide of hydrogen and irrigated with sterile water. The pleura was then opened under pressure of 15 mm. of mercury. It was at once seen that the lung was distended to about two-thirds of its capacity, mottled, and rosy pink in color. Complete pulmonary distention could be secured by raising the pressure to 25 mm. The lung was collapsed and distended several times so as to observe the working of the apparatus. The pleural cavity was then explored by hand and by sight, and some dense adhesions found immediately beneath the scapula. This region was thoroughly aspirated through the chest wall, the needle being also guided by a hand in the pleural cavity, but no pus could be found. The pressure was then raised to 30 mm. while the pleura and superficial wound were being closed. The pleura was quite friable on account of granulations resulting from the first operation, and closure by suture was difficult. A small drain was left in the superficial part of the wound, and gauze thoroughly wet with normal saline solution and covered with rubber dam and gutta-percha tissue was bandaged over it, so that in the event of a slight leakage there would be less liability to pneumothorax, saline solution being drawn in instead of air. The patient was then sent to the ward. Ten minutes later he had entirely recovered from his anæsthesia so that he held conversation with those about him. At no time was there any dyspnœa.

His recovery was quite uneventful, and much to my surprise and delight his expectoration ceased, perhaps because the comparatively large rib resection permitted the cavity to become obliterated. The temperature on February 22 reached 102.6°; it steadily declined to normal on February 28, and on March 20 he was discharged practically well. There was still a mucopurulent expectoration amounting to about 2 or 3 drachms a day instead of the copious flow which existed on his admission.

I consider that this case was a most severe test of the Meltzer method of anæsthesia, because of the foul and septic condition of the discharge from the pulmonary cavity. In spite of this there was no pneumonia and not even a bronchitis.

The most notable feature of the anæsthesia, as mentioned above, was the total disappearance of the noisy rattling respiration which existed during the administration of the ether by the usual method. The preliminary anæsthesia was supervised by Dr. A. R. Chamberlain and the insufflation anæsthesia was managed by Dr. Elsberg.

SOME OBSERVATIONS REGARDING THORACIC SURGERY ON HUMAN BEINGS.*

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IN order to further the evolution of thoracic surgery, it seems to me the duty of every operator in this field to publish in full his personal experiences, favorable or unfavorable. In this way observations made by one may inure to the benefit of another; mistakes recognized as such in the course of an operation may be avoided in future similar cases. In thus working together, piling one stone—rough or cut—on top of the other, we shall soon have a structure that will be a credit to its builders, let us hope. We may then be in a position to make the work done within the thorax compare favorably with our daily triumphs in abdominal surgery.

So far my own experience in thoracic surgery upon the human subject, with the aid of differential pressure apparatus, has been limited to the following cases:

For diseases of the pleura (acute empyema) 3

For diseases of the lungs (abscess) 3

For diseases of the œsophagus (cancer) 4

All these operations have been done with the positive differential pressure apparatus, as described and illustrated in a previous paper (*Jour. Am. Med. Assn.*, Dec. 11, 1909).

The universal differential pressure chamber, of which the positive one forms a part, also described in said article, requiring a special room on account of its dimensions (16 x 8 x 8 ft.), is still at the Rockefeller Institute, pending the completion of the new Thoracic Department now in course of construction at the German Hospital. This chamber permits of the application of negative or positive or combined pressure. With its help I shall try to ascertain whether the effects of

* Read before the American Surgical Association, May 3, 1910.

positive and negative pressure upon the sick human being are identical, and if not, wherein they differ. The machinery is arranged for triple reserves, in case of a break-down, but without unnecessary duplication of any of its parts. (Conf. *Jour. Am. Med. Assn.*, l. c., and *N. Y. Med. Rec.*, March 19, 1910.)

I. PLEURA.

Acute Empyema.—To the many methods of treatment hitherto employed for this trouble, the differential pressure method forms a comparatively recent addition. Further experience is needed to thoroughly establish the procedure. The ideal operative method of treatment for this affection would, of course, be incision and evacuation of the abscess, with or without resection of the rib; inflation of the lung until the pulmonary pleura is in close contact with the costal; application of an air-tight dressing.

Sauerbruch states that he has done this in a number of cases and that, at the first change of dressing about a week later, superficial granulation was all that was left, which then was allowed to heal under ordinary dressings.¹

Personally, it has not been my good fortune to obtain such favorable results, and I believe it will be but rarely possible in these cases to eliminate with certainty a partial pneumothorax at the time of the operation. It is difficult to fully distend the inflamed and infiltrated lung tissue; some space will nearly always remain between its surface and the thoracic wall, even under high differential pressure. But, despite these conditions, I believe the method well deserving of further trials. Of the three cases thus treated in April and May, 1909, I will here briefly relate the history of one:

Boy 4½ years; ² sick for ten days. Inflammation of the two lobes of the left lung, also lower lobe on right side, pleuritic effusion filling entire left cavity. April 3, 1909, resection of fifth rib in axillary line; pus, with masses of coagulated fibrin-

¹ *Journal of the Am. Med. Assoc.*, 1908, li, 809.

² This was the first case operated on at the German Hospital under differential pressure.

ous substance thoroughly removed. Then head of patient placed into positive differential chamber and pressure gradually increased up to a maximum of 14 mm. Hg. (about 18½ cm. water). During this procedure the lung is carefully observed; it is seen that it rises up to within about 1½ inch of the thoracic wall, refusing to be distended further; with each inspiration it is drawn in again. On the whole, its expansion is rather unsatisfactory; color, dark bluish-red; pressure not raised higher, as consequences cannot be estimated. Dry aseptic mammoth dressing with gauze and cotton without drain or rubber covering of wound. Patient stood operation nicely; lips red when returned to bed.

April 5: Pulse 84; temperature normal; good condition.

April 9: Same good condition; little cough. First change of dressing under superficial general anæsthesia and differential pressure; narcosis started outside; patient then put in position; differential pressure of 12 mm. Hg; dressing removed; healthy granulations; lung just in front of wound, of much better color (pink); very little discharge even after pressure has been slowly increased to 16 mm.

April 12, ninth day after operation: Temperature suddenly rises to 104°; 6 P.M., second change of dressing under differential pressure; external wound presents a level, granulating surface. Dressing forceps gently pushed into thoracic cavity fails to give exit to pus. Now pressure gradually increased; when reaching 16 mm. there is a sudden gush of seropus, shooting high up, after which no further secretion can be brought out. Short cigarette drain. Temperature promptly drops and remains normal. From now on, the patient is daily placed into the apparatus for increasing periods of time, in order to have him breathe under pressure. Soon cigarette drain removed. Patient is discharged at end of fourth week, with wound firmly closed.

Comment.—Although it is not uncommon for children, when operated upon with open incision and drainage, to be discharged within three to four weeks, with the empyema cavity closed, the simplicity of the treatment in this case, as also the advantages of the breathing under differential pressure during the after-treatment, greatly impressed me.

In a second case that soon after presented itself, I again

employed this method. In this instance a rubber dam was placed over the incision, allowing the fluid to escape into the surrounding dressing but preventing the entrance of air. Here, too, drainage for a short time became necessary later on. Again rapid, satisfactory healing of cavity occurred.

The third case entered the hospital profoundly septic and could not be saved.

Kausch, who operated upon some such cases under negative pressure, gives expression to the firm conviction that after-treatment under differential pressure insures more speedy and certain healing of empyema than any other known method. He also recommends change of dressings under differential pressure in order to prevent collapse of the redistended lung and the tearing of fresh adhesions.

Although the reported cases treated by this method are but limited, the results are such as to certainly warrant its further trial.

II. LUNGS.

Three Cases; Lesions due to Bronchiectasis.

CASE I.—*Incision and Drainage of Large Bronchiectatic Abscess.*

Man, thirty-two years of age; pneumonia seven years ago; since then sick; cough with pus expectoration during last two years; sputum foul; copious.

April 23, 1908, under local anæsthesia, resection of rib; lung adherent to chest; aspirator encounters abscess about 2 in. below surface; is opened with Paquelin cautery; from this moment on no further expectoration; abscess discharges through wound; expectoration recurs when external opening becomes clogged; patient, who lives in the country, goes home.

April, 1909, he returns much improved in general condition; small, not discharging sinus in side; expectoration of several ounces of fetid pus every morning.

Operation (April 29, 1909).—Differential pressure ready for use with patient's head inside of the chamber. Resection of seventh and eighth ribs, involving fistula; tract of canal excised and cavity in lung, the size of a small apple, opened; into this empty two bronchi of larger size. It is decided to treat the

patient conservatively, at least for the present. Therefore, cauterization of bronchial lumina and inner abscess membrane; tamponade with iodoform gauze; positive pressure not turned on.

Comment.—Having the differential pressure ready for instant use, should it have become necessary to turn it on, was most reassuring.

Later History.—September, 1909, the patient was brought to the hospital in a somnolent condition. Diagnosis: brain abscess; claimed by relatives and taken home, where he died.

CASE II.—*Multiple bronchiectatic abscess; partial pneumectomy, right inferior lobe.*

Boy, six years of age; two years ago laryngeal diphtheria, requiring intubation *in extremis*; three weeks later, expectoration of pus sets in; loses weight rapidly; left empyema.

Operated upon June, 1908, by Dr. G. R. Pisek at the Post-Graduate Hospital; spasmodic cough continues day and night with abundant expectoration of foul-smelling pus four to six times in 24 hours; no tubercle bacilli found; enters German Hospital with high fever which slowly decreases but never reaches normal; ronchi over both lungs; X-ray examination points to bilateral infection of lower lobe.

Plan of operation: resection of ribs and pneumolysis on left side. May 12, 1909, under anesthol anæsthesia and Trendelenburg's posture, on specially designed new table (see below) resection of sixth and seventh ribs, seventh being the one formerly operated upon. Intercostal tissues ligated and excised; good exposure with pillow under opposite side; lower right lobe tightly adherent to costal pleura and diaphragm by old bands which are divided bluntly or with scissors; its color is reddish blue, also adjacent part, evidently belonging to right middle lobe, whereas upper lobe appears yellowish rosy in color, being normal; lower lobe brittle, tears on loosening in many places; on account of its evident disease and multiple unavoidable injury, extirpation is decided upon, the rest of the affected lung tissue then to be treated by pneumolysis; firm adhesions between upper portion and chest wall slowly divided and pushed off, again entering lung tissue; then main bronchus gradually exposed; double ligature and division of vessels is nicely accomplished; branches of pneumogastric nerve not recognized; tightly adherent lymphatic glands are annoying; isolated bron-

chus clamped and crushed with Doyen's intestinal crusher, as described in my former article (*Jour. Am. Med. Assn.*, Dec. 11, 1909); bronchus inverted; entire procedure can be neatly done, same as in the animal. When placing first top suture, narcotizer gives warning of weak pulse; palpated through thoracic wound, heart is found to beat slowly and irregularly; respiration very superficial; no cyanosis. Operation immediately stopped; intravenous infusion; no improvement; mass ligature quickly placed around bronchial stump and patient removed from apparatus. By this time heart had stopped beating; pupils dilated; all efforts at resuscitation futile. No postmortem allowed.

Comment.—1. Operation would have been feasible without differential pressure, but use of latter was most reassuring.

2. In view of multiple localization of trouble, the intended pneumolysis would have been preferable to attempted extirpation; the various rents in the lung tissue that occurred in the course of operation would in that case have had to be stitched up; this the boy would probably have stood nicely.

3. As there was no cough during anæsthesia and pus had been evacuated by coughing before starting operation, it is to be assumed that aspiration of pus did not occur, and such accident therefore was not, in part, responsible for the sudden change in the action of the heart during the operation. Still, Koerte's advice, to put these patients under superficial anæsthesia throughout the operation, in order to enable them to expectorate, had evidently better be strictly followed.

4. Isolation of bronchus, crushing and inversion of stump, in the human subject nicely feasible, same as in animals. The presence of tightly adherent glands at base of bronchus is annoying.

5. In this case heart seems principally to have been responsible for the death; attempt at explaining the giving out of the heart in the course of the operation, see below under œsophagus.

CASE III.—*Bronchiectatic abscess of lower lobe of left lung; partial pneumectomy.*

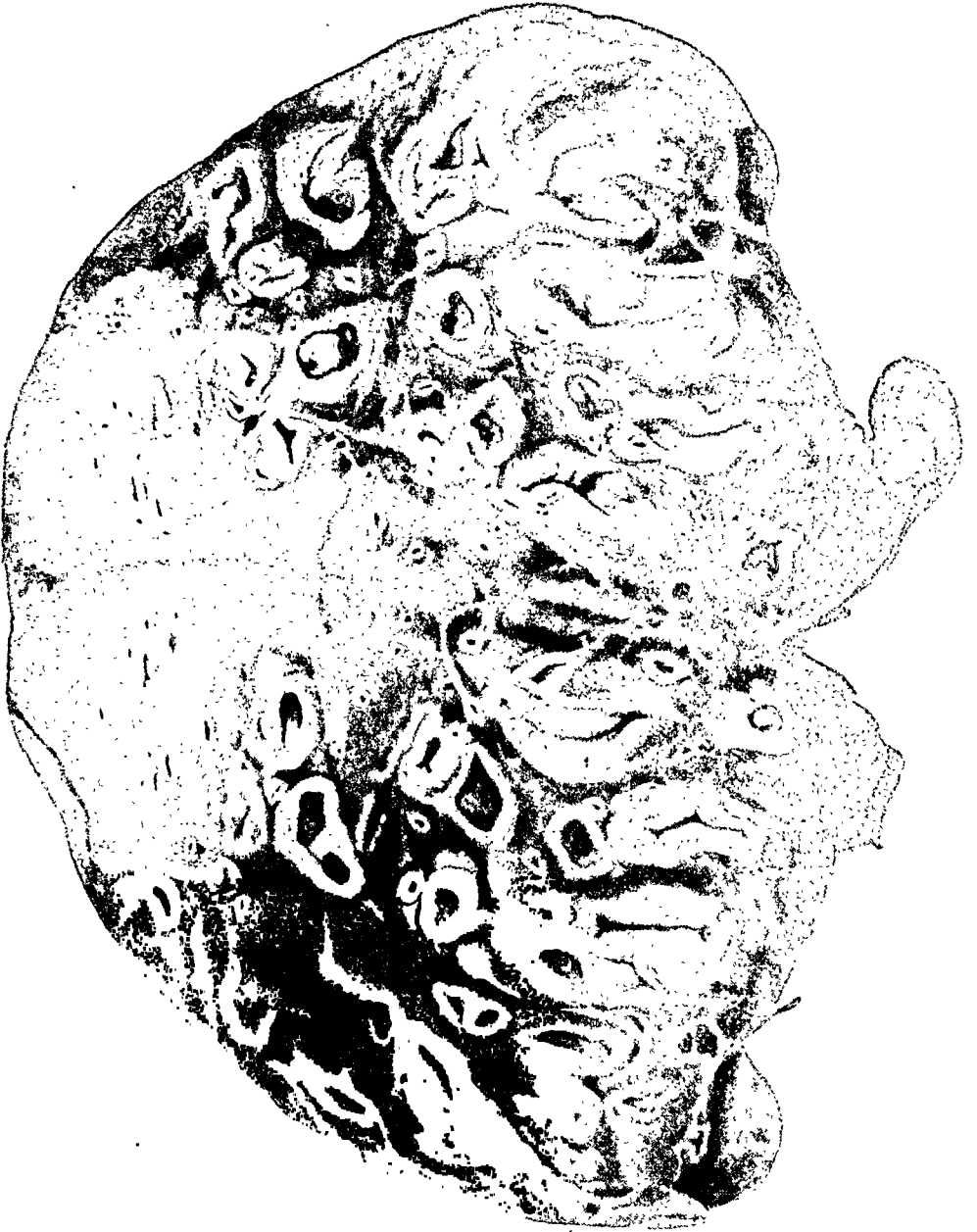
Boy, thirteen years of age; operated upon last summer for

lung abscess by Dr. Martin Rehling, adjunct attending surgeon to the German Hospital. The differential pressure apparatus not being on hand at that time and no adhesions present, immediate severe collapse on table after incision of pleural cavity; lung pulled forward, stitched to ribs; dressing; boy recuperates. Lung incised after 48 hours, drained for many months; wound then closed; coughs up a few ounces of fetid pus every day. Never tubercle bacilli. Re-entered hospital. Clinical examination and X-ray point to seat of trouble in lower left lobe alone.

Decision: Extirpation of lower left lobe. February 23, 1910, anesthol anæsthesia; patient is cyanotic before he is washed up; either too much anæsthetic or aspiration. Narcotizer claims boy coughed up some pus during beginning of anæsthesia, although the patient had tried to thoroughly empty cavities just before starting; oxygen added. Incision in seventh intercostal; 6 plus pressure all the time; again free pleural cavity entered. Lung adherent to chest wall only in immediate neighborhood of original incision; upper lobe feels soft and normal; lower more resistant; in the attempt to gradually loosen the lower lobe from its normal firm union with upper lobe, the latter is slightly torn; tampon; in order to form pedicle, temporary ligature (gauze-strip) of portion of superior lobe becomes necessary; clamp placed peripherically; division; now ligature of vessels as in animal experimentation,³ nicely feasible, but impossible to reach those at lower circumference of bronchus on account of the firm lung adhesions downwardly. At this time narcotizer, who, during the latter part of the operation had used only oxygen, reports pulse weaker. Operation hurried and lung loosened from chest wall, after silk ligature close to the latter; division between it and clamp; heart beats slowly; intravenous infusion, 800 c.c.; in course of latter last large vessel alongside bronchus is ligated doubly and divided; operation then interrupted; wet towel on top covers wound; patient recuperates nicely; still, hurry is needed; bronchus perfectly freed; after silk ligature has been placed proximally around same, narrowing its lumen (Friedrich), crushing centrally of distal clamp with improved Doyen, which allows of graduation in compression (see Fig. 2). Silk ligature around crushed portion; division between the same and clamp; large stump; Paquelinization; no inversion with top sutures, in order to save time; tampons,

³ Jour. Am. Med. Assoc., 1. c.

FIG. 1.



Inferior lobe of left lung obtained by pneumectomy for bronchiectatic abscesses; actual size of specimen, divided by section cut. The pronounced distention and contortion of almost the entire bronchial tubes is well marked.

FIG. 2.



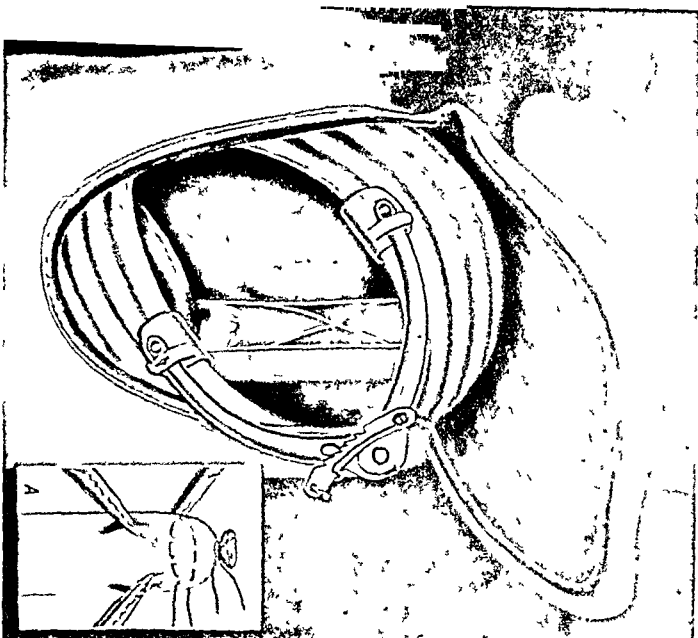
FIG. 3.



FIG. 2.—Schede's incision for raising a skin muscle flap, inclusive of the scapula. It begins at a point about 2 in. from the border of the sternum and $\frac{3}{4}$ in. below the clavicle, touches the tenth rib, and ends opposite, about 2 in. side-ways from the spinous process of the second or third dorsal vertebra. It is of advantage to have the skin muscle flap well overlap the intercostal incisions in order to insure air-tight occlusion of the thoracic cavity. Above, exposure of the first rib with the subclavian artery and vein and the brachial nerve plexus is not absolutely required, but the three upper ribs override easier when compressed by the rib-spreader, if all of these parts are thoroughly exposed.

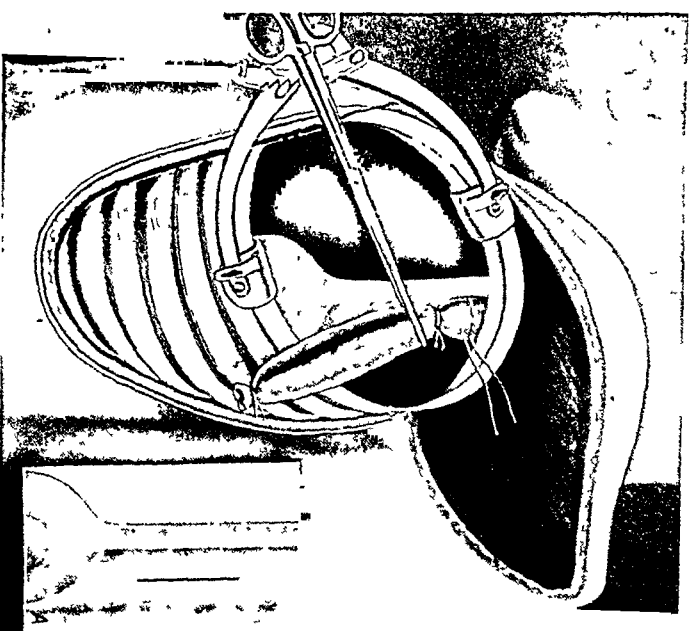
FIG. 3.—The flap raised. With the arm pulled up perpendicularly, the scapula takes a position at right angles with the thorax. When the patient's head is in the differential pressure apparatus, the arm forms a right angle with the thoracic wall. Then by turning the arm inwardly 180° (or the forearm 360°) the scapula moves away from the chest and can be well held out of the way. A, incision in sixth; B, incision in third intercostal space.

FIG. 4.



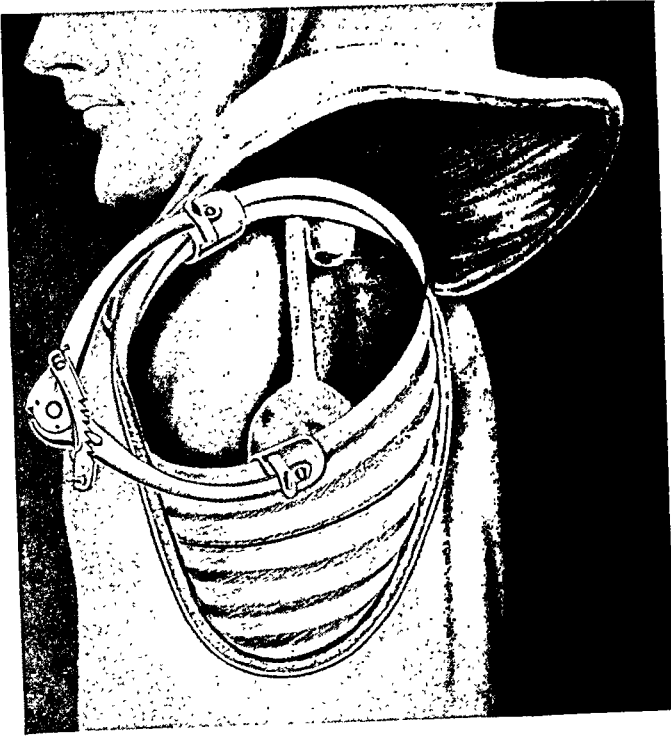
Incision in sixth intercostal space; rib-spreader in place; to the left, lung and diaphragm visible; to the right, the descending aorta still covered by the continuation of the costal pleura; next to it, the esophagus, divided; lower end inverted; the upper tied with silk. Pneumogastric nerves run on either side, with their anterior oscillation. A, lower stump of the esophagus ready for inversion, with the purse-string suture in place. It is best to pull the tube apart with three clamps.

FIG. 5.



Incision in third interspace; rib-spreader turned around, as scapula is in the way; esophagus exposed by incision about 1 in. to the outside of the common carotid, which remains covered with pleura, as also does the aortic arch (A). The portion of the esophagus harboring the tumor, pulled from behind the aortic arch, tied and clamped, ready to be divided with Paquehin cautery, completing the resection. The first of the two superior purse-string sutures in place, for inversion of upper stump.

FIG. 6.



Interior of the cavity as it appears after completed double inversion of upper œsophageal stump. Note below the latter the groove in which the œsophagus rested.

FIG. 7.



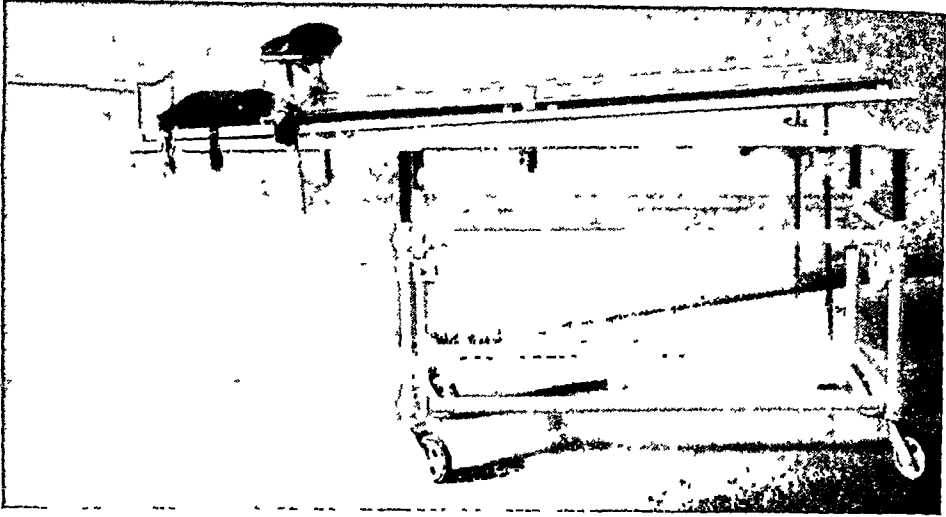
X-ray taken in oblique diameter with the patient's left arm raised up perpendicularly. Esophageal stricture made visible by bismuth paste, which has been swallowed just before the radiograph was taken; the lower end of the dark shade corresponds to the eighth intercostal space. To the left of this shadow (right side of patient), spinal column; to the right (left side of patient), heart and aortic arch. The figures "8" mark the eighth rib posteriorly and in front.

FIG. 8.



Resected portion of œsophagus, actual size of the specimen as it appears to-day. At either end the normal mucosa appears, the rest of the cylinder occupied by the infiltrating epithelioma. On left side of upper portion projects stump of the divided hypogastric nerve. The tumor occupied a distance from two inches above the cardia to a place underneath aortic arch.

FIG. 9.



Special operating table for thoracic work in use at German Hospital. Note hinge for Trendelenburg's posture at extreme left. Head-rest removable. Attachment for bending of patient's thorax movable longitudinally. Table vertically adjustable.

FIG. 10

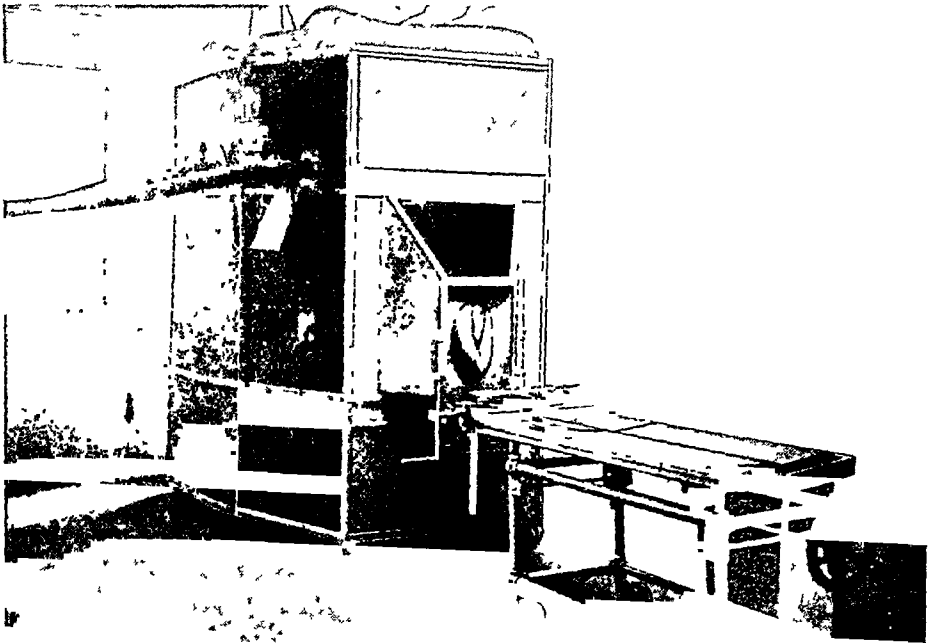
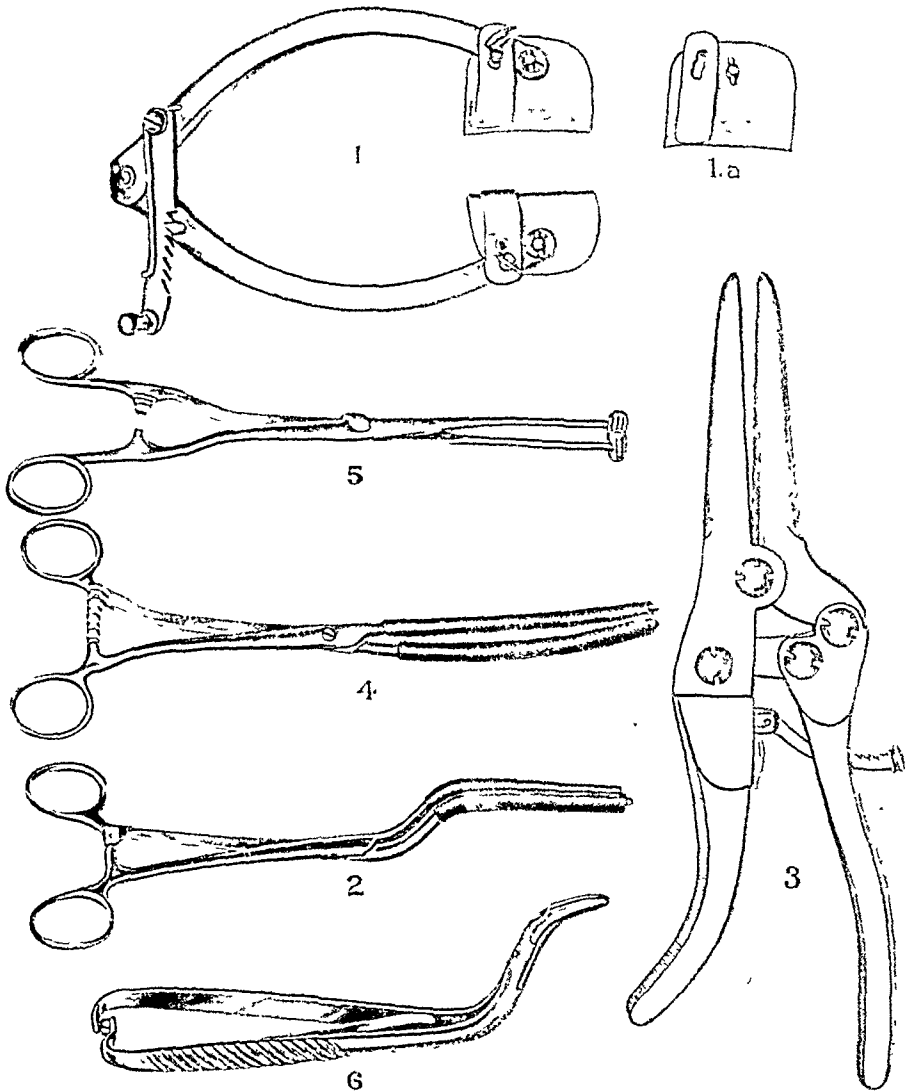


Table moved up to positive differential pressure cabinet, head-rest removed. Patient's head projects out over table and is adjusted in collar of cabinet without changing position of body.

FIG. 11



Instruments found useful in thoracic work: 1, Friedrich's rib-spreader; 1.a, exchangeable larger blade; 2, bayonet clamp, branches ensheathed in rubber tubes; 3, improved Doyen crusher; 4, large curved intestinal clamp, again branches covered with rubber; 5, author's diaphragmatic forceps; 6, improved "Küster's swan" (needle-holder).

soaked in Lygol's solution, placed against stump, emerge at posterior angle of wound; layer sutures, thoroughly pressing tampons into angle; wound covered with rubber tissue to make cavity air tight as in empyema; mammoth dressing; patient's lips red; normal, regular respiration; 15 minutes later, in bed, pulse regular, well palpable at femoral, but weak at wrist (56); slows down still further in spite of stimulation; patient dies about one hour after operation, without regaining consciousness.

The specimen obtained is very interesting. The entire lobe harbors exceedingly distended and contorted bronchioles (Fig. 1). Postmortem not allowed.

Comment.—1. The fact that patient reached his bed with a pulse of 56, instead of the usual rapid pulse after prolonged operations, breathing remaining normal, points to vagus reflexes, probably due, in part, to ligation of a branch, when tying the main vessels. The branch of the pneumogastric nerve, running from its main trunk with the vessels on to the bronchus, could not be seen in this case; still, special efforts should have been made to single it out and divide it. F. Reich has shown that the division of a larger branch or branches of the pneumogastric is well borne, whereas blunt injury, as pulling, clamping, tying, often causes serious reflex symptoms. For this reason, it may be advisable in future similar cases to resect the lung, about 1–2 inches peripherically from the first division of the main bronchus instead of extirpating it with the help of inversion of the bronchial stump, although here, too, the smaller branches of the vagi accompanying the bronchial tubes would have to be ligated with the vessels.

Friedrich found the distal bronchial stumps insensible, but noted severe vagus reflexes on compressing or severing the proximal end of the bronchi, when pressing with a gauze mop against the mediastinum, and that more pronounced in the human being than in animals.

2. Technically, the operation went smoothly, the only disturbance being the narcotizer's warning.

3. It seems advisable in cases of this kind to primarily drain the lung abscess or abscesses externally, if necessary even for a second time, in order to guard against aspiration.

4. It seems further advisable to use superficial nitrous oxide-oxygen anæsthesia, instead of other narcotics for the more serious thoracic operations, in order to reduce to a minimum the unavoidable influence of the narcotic upon the heart.

5. The sudden shock seemed again to be due to vagus reflex. Discussion on possibility of avoiding same in thoracic operations, find below under "comment" on the case of resection of œsophagus.

The fatal issue in my two cases of partial pneumectomy, of course, was very depressing. However, both patients were bad risks; they had been sick for years, had expectorated foul pus for a long time, and were feverish and anæmic when they came under my care.

Criticizing the work, I would repeat that superficial anæsthesia, allowing the patient to expectorate all the time, seems to be a primary requisite in operations on younger patients; for older cases, local anæsthesia, plus a still more superficial general one, would probably be advisable.

Resection seems preferable to extirpation, provided the first division of the main bronchus is not involved in the disease, in which event, of course, extirpation has to be done.

In case typical extirpation is indicated, cocainization of the pneumogastric that runs perpendicularly downward through the thoracic cavity and crosses the main bronchus close to its base at right angles may be a recommendable procedure; it would inhibit the conductivity of the nerve during the operation. Such cocainization would have to be done as high up in the pleural cavity as possible. It would be an aid in overcoming the symptoms of immediate vagus reflex, but should not make the surgeon careless and make him forego search for and division of the nerve branch that runs with the vessels up to the hilus of the lung to be extirpated. Cocainization of both pneumogastrics in experimental surgery on animals has caused death, as was to be expected.

The question as to the best operative treatment of bronchiectasis is still an open one and, on account of the multilocular occurrence of the disease, certainly by no means a simple one. If one lung only is affected and the pulmonic

pleura not adherent to the costal pleura, the injection of nitrogen for bringing to contraction tuberculous lung cavities, as recommended by Forlanini, Murphy, and Brauer, has been tried with good result by Forlanini, Petersen, and Schmidt in the treatment of bronchiectatic lung abscess.

If both pleural portions have become adherent, pneumolysis might be done, but care should be exercised not to injure the lung tissue; and if tears do occur, they should be immediately closed air-tight by suture. Difficulty commences when a lobe harbors many smaller bronchiectatic abscesses and when a number of bronchioles communicate with the exposed cavity of a larger abscess.

For these cases Friedrich advises gradual breaking down of the dividing walls under very superficial anæsthesia, and exposing the parent bronchi, which, later on, have to be closed by suture, the operation to be done in a number of sittings.

Koerte advises resection of the lung for bronchiectatic affections. My own results of total unilateral pneumectomy in dogs (17 recoveries out of 21 operations) (*Jour. Am. Med. Assn., l.c.*) stimulated me to proceed likewise in the human subject.

In the interest of the advance of thoracic surgery in these cases, a more conservative attitude is advisable, explaining to the patient or his relatives that a number of operations at different sittings may be safer than radical work in one sitting, although the excellent result obtained in the latter way by Gluck may well tempt one to follow his example.

On the other hand, the excellent recovery of one of Kuettner's patients, with bronchiectatic abscess, in whom he opened the pleural cavity after multiple rib resections, liberated the adherent lung and allowed it to contract, should induce us to go rather slow and first try conservative methods of treatment in these cases.

III. ŒSOPHAGUS.

a. Three Exploratory Thoracotomies.

CASE I.—Man, thirty-seven years of age; obstruction found in lower portion of œsophagus, 32 cm. ($12\frac{1}{2}$ in.) behind teeth.

Operative Plan: Thoracotomy in eighth intercostal; if

tumor be found extirpable, typical excision with œsophagogastrostomy.

April 17, 1909: Anesthol anæsthesia; incision in eighth intercostal, 14 in.; plus pressure = 6 mm. Hg; no difference in breathing when opening cavity; lower lobe adherent to diaphragm and costal pleura, due to old pleurisy; loosened bluntly; many strong adhesions cut; then lobe pushed upward and forward; œsophagus exposed; lower end of infiltrating hard nodular tumor found to be 8 cm. (3 inches) above cardia; it extends several inches upward and passes underneath the arch of the aorta, with which it is, however, not closely connected; good exposure; attempt at radical operation appears inadvisable. Three silk pericostal retention sutures; soft tissues closed with three layer sutures of catgut; silk for skin.

Patient stood operation nicely. Following day, pulse and temperature normal; soon out of bed; first change of dressing on the seventh day; primary union except at two places, where thin pus is retained due to fascia necrosis. Slow healing of developing sinuses. Pericostal silk sutures must be removed. Such of absorbable material (chromicized gut) preferable, penetrating through silk hole in centre of lower rib, to avoid interference with nutrition by compression of the intercostal artery (Friedrich). Patient refuses further operating. He was presented before the N. Y. Surgical Society of April 28, 1909 (ANNALS OF SURGERY, 1, 642).

CASE II.—Man, sixty-three years old; pronounced chronic bronchitis. Œsophageal sound and X-rays place tumor about $1\frac{1}{2}$ –2 inches below aortic arch. In view of the oblique descent of the ribs in the human being (in contradistinction to their almost horizontal course in the dog) it appeared probable that the tumor could be reached through eighth intercostal; this access would have given a chance to attend properly to lower stump after the intended resection.

February 14, 1910: Intercostal incision, 40 cm. (15 in.) long, passing just beneath lower end of scapula; (pressure = plus 6 mm. Hg). No change in respiration after incision of pleural cavity. Many adhesions between lung and costal pleura divided between two ligatures or stripped off bluntly. Further up a hard irregular mass is palpated just below aortic arch corresponding to the place indicated by the X-rays. It is so high within the pleural cavity and so far away from the surface of the thorax, that, in spite of bending the patient's chest by

raising the cross-bar of the special operating table, the seat of the disease cannot be brought out in such a way that good surgery would be possible. An additional incision would have been required in about the third or fourth intercostal space, but here the scapula was in the way. In view of the patient's age, further work desisted from. Three silk retention sutures, drilling through lower rib and embracing upper one. Patient stood operation nicely. Two days later, out of bed.

February 20, first change of dressing. Wound puffed up in a few places; retention of pus, due to fascia necrosis; 2½ weeks later patient begins to lose weight. Therefore, March 12, typical gastrostomy (Kader). Again necrosis of fascia and split rectus muscle; leakage of gastric contents; fistula closed by double row of stitches. Stomach wound reopens; inanition; exitus, March 30. No autopsy.

CASE III.—Man, fifty-six years of age; localization of tumor behind aortic arch, at a point corresponding to second and third dorsal vertebræ, sound being caught about eight inches from teeth. X-rays corroborate this localization.

March 14, 1910: Curved skin incision surrounding scapular base with convexity downward, flap raised; curved circumcission of muscular attachment of scapula in its lower half; bone raised with sharp retractors; this gives access, under difficulty, to fourth intercostal; incision; no adhesions between lung and chest wall; in order to gain better access, skin muscle incision to a point beneath left mammary line has to be added. Resistance felt right underneath aortic arch. The field of operation again lies too far upward for proper asepsis, especially as scapula is not sufficiently out of the way. Therefore, closure of wound as in former case.

Patient stood operation well. Pulse at close 96, but weak; had had no hypodermic or other stimulant during operation. Intravenous of 800 c.c. after reaching bed. March 16, doing nicely; soon out of bed; later developed empyema which required drainage.

Comment.—When operating for œsophageal strictures situated thus high up, it is absolutely necessary to get the scapula well out of the way.

The experience gained in these three exploratory operations led up to a resection of the œsophagus, in which Schede's method of getting the scapula out of the way was employed. I

tried it first on cadavers; also tried such exploratory incisions as enable one to do proper surgical work at the upper as well as lower end of the tumor that involves the œsophagus. The work on the cadaver I was permitted to do at the morgue, through the courtesy of Dr. F. W. Schultze, general medical inspector under the Commissioner of Public Charities of the City of New York.

It was found that with the Schede incision⁴ down to the tenth rib, raising a large skin muscle flap along with the scapula, and twisting the forearm for 360° inwardly or the arm 180° , the raised scapula takes a position at right angles with the chest, exposing fully the upper nine ribs. (This, however, seems to be the case in frozen cadaver only.) In the one experience I had with the living, as described further down, the scapula did turn up so as to form a right angle with the chest, but did not stay up and had to be held in position. On dividing the third intercostal space down to the border of the sternum, with the help of double ligation and division of the internal mammary plexus, it was found that the upper three ribs could be made to act as a door does on hinges, the rib-spreader having pushed the third over the second and the second over the first (Figs. 5 and 6); the aortic arch and upper part of œsophagus can now be well reached. In order to do good surgery also as regards the lower stump, a second incision in the sixth or seventh intercostal is advisable. The latter should, of course, be done first, if the œsophageal bougie had located the stricture in the lower portion of the œsophagus.

Investigations on a cadaver made at a former occasion at the German Hospital, through the courtesy of Dr. W. G. MacCallum, the pathologist of the institution, had shown that the comparatively small human stomach cannot be pulled up further than 3-4 inches above the diaphragm, for the reason that in the human being the duodenum is attached and not entirely free within the abdominal cavity, as in the dog. Œsophago-gastrostomy, the ideal operation for the removal of an œsopha-

⁴ Schede devised this incision in conjunction with the removal of the entire chest wall for the cure of patients afflicted with chronic emphysema of long standing.

geal neoplasm, can therefore be done only for resection of a tumor situated in the lower portion of the œsophagus. For tumors in the middle or upper portion of the œsophagus, excision of the growth with double inversion (purse-string suture) and gastrostomy will be the operation of choice. Experimental work done on dogs has proved to me that this is nicely feasible; the dogs live and thrive. Exit of the proximal stump through an intercostal space—as is claimed by some to be imperative—I do not consider necessary. Of course, patients ought to be asked first whether they are satisfied to take their food through a gastric fistula for the remainder of their lives. Some may not want to do this but prefer to die, although they may have the taste of what they eat and drink by first chewing their food. The masticated material is then blown through a long rubber tube, connected with the rather large rubber drain worn in the gastric fistula into the stomach directly (Trendelenburg), or it is spit into some broth or other kind of fluid and poured into the stomach. Chewing stimulates the stomach secretion; the saliva is thus also made use of.

In order to improve the functional result also for these patients, ways will have to be found to unite later on the proximal œsophageal stump with the gastro-intestinal tract in some manner. Such operations have already been done by several surgeons. Gluck and Perthes have successfully connected an œsophageal opening at the neck with the gastric fistula by means of an antethoracic prothesis. Roux, Kocher, Tuffier, and Kuemmel have made that connection subcutaneously, using a coil of the small intestine.

b. Resection of Œsophagus for Carcinoma.

CASE IV.—F. L., male, aged forty-three years (referred to me by Dr. G. H. Joslin of Hamden, Conn.), had been sick for six months; increasing difficulty in swallowing. X-ray photograph (Fig. 7) and œsophageal sound placed stricture 32 cm. (12½ in.) behind teeth, or about 8 cm. (3 in.) above cardia. After sounding with bougie à boule No. 40, swallowing much easier, and patient gained 8 pounds in first week, 2 pounds in second.

Operation (March 31, 1910).—Under nitrous oxide-oxygen

anæsthesia (Dr. R. C. Coburn), outside of pressure apparatus, curved incision down to tenth rib (Fig. 2), dividing borders of pectoralis major and latissimus dorsi muscles sufficiently, after which scapula can be well turned up with the large skin muscle flap. By means of the above described twist of the arm it is brought into a position away from the chest (Fig. 3), where it is surrounded with sterile gauze and bandage; ligation of divided vessels. Thereupon patient's head is placed in pressure chamber. Incision in sixth intercostal space (Fig. 3A), about 10 in. (25 cm.) forward from angle of ribs; pressure = plus 6 mm. Hg.; rib-spreader put in place (Fig. 4); lower lobe of lung has many adhesions to costal pleura and diaphragm, which are partially divided between two ligatures, partially broken up bluntly. Palpation shows tumor in lower end of œsophagus, about one inch away from cardia; infiltration reaches upward to a place underneath aortic arch; division of pleura; œsophagus gradually loosened from its bed and encircled by finger above cardia. Pulse at this time not quite as strong as before. Hypodermoclysis (1500 c.c.) given in thigh. Careful stripping off of nervi vagi, above cardia; on palpating infiltrated œsophagus further up, it seems to be possible to resect it. After laying of purse-string suture (Fig. 4A⁵), primary division of distal end between two silk ligatures with Paquelin. Upon loosening lower part of œsophagus, it seems that cardia could be easily pulled into thoracic cavity. Typical inversion (Fig. 4); five silk top sutures.

Second incision in third intercostal space (Fig. 3B); in order to avoid preparing of mammary gland forward, incision is carried to a place underneath the external border of the breast and then lengthened sufficiently backward to the angle of the rib, so that, with rib-spreader in place, the area above aortic arch can be nicely reached⁶ (Fig. 5); pleura divided to the outside of common carotid (Fig. 5A); œsophagus immediately reached; loosened,

⁵ Special care is required not to penetrate into the lumen of the œsophagus when placing the purse-string suture. The muscular coat of the human œsophagus is much thinner than that of the dog.

⁶ It is interesting to note how the rib-spreader pushes the third rib over the second, and this one again over the first (Figs. 5 and 6), although the intercostal incision is not carried to the border of the sternum with ligation and division of the internal mammary plexus, as this was first observed on the cadaver. The three ribs thus pushed over one another, the rib-spreader turns them as a unit around the longitudinal axis of about the second rib, making them act as a swinging door does upon its hinges.

encircled by finger and followed down from above behind aortic arch; with fingers of right hand introduced from below through the incision in sixth intercostal space, the mass is loosened all around. To pull up the mass now, from beneath the aortic arch is found impossible. Cause: the nervus vagus is a unit with it further up. On trying to prepare it off, the tumor mass is entered, but œsophageal cavity not opened. Hence, of dire necessity, the right vagus, viz., the one running on the medial side of the œsophagus, is divided, and now the tumor pushed and pulled from underneath aortic arch, so that it appears above (Fig. 5). It cannot be entirely freed and it is discovered that the nervus vagus on the right side of the œsophagus enters the mass also from above. There is no possibility of stripping it off and, inasmuch as lower divided end of œsophagus cannot be inverted into the tumor mass, operation cannot be broken off, but has to be gone on with. Division of nerve; purse-string suture; amputation of tumor in healthy tissue; double inversion of œsophagus, which is nicely feasible, the stump appearing in the uppermost vault of the thorax, just where the œsophagus enters the pleural cavity (Fig. 6). When bluntly handling the nervi vagi at the lower end of the œsophagus and again after dividing the pneumogastric nerve above the tumor, narcotizer as well as assistant who holds the arm of the patient, report greatly deteriorated heart action. Closure of intercostal incisions with chromicized gut, drilling through lower rib; tying same after the two ribs had been temporarily held in place by two pericostal silk sutures which are afterwards pulled out; skin muscle flap with scapula turned down; the divided serratus fibres are stitched together, as well as those of the pectoralis major and latissimus dorsi; second continuous suture of fascia on top; careful skin suture, working from both sides; dressing. The patient is taken out of apparatus with lips red, pure oxygen having been administered during last $1\frac{1}{2}$ hours; as soon as the head is removed from the apparatus, his hitherto red lips turned a deep blue. The jaw was pushed forward, the tongue pulled out, and oxygen again administered. Subcutaneous stimulation and intravenous infusion. During the latter the patient expired, about ten minutes after completion of the dressings.

Pathologic examination of the tumor (see Fig. 8) by Dr. MacCallum proved it to be an epithelioma.

Comment.—1. Technically, the operation is nicely feasible.

The formation of Schede's flap in order to get the scapula

thoroughly out of the way seems to be a recommendable preliminary routine procedure for the resection of malignant strictures of the œsophagus. It permits of entering the thoracic cavity, wherever it is required; it enables the surgeon to properly reach and master the deep-seated operating field, and maintain asepsis; it meets every emergency. The multiple intercostal incisions do not increase in any way the seriousness of the operation.

Regarding the entrance into the thoracic cavity, intercostal incisions seem preferable to resection of ribs, although the rib-spreader, when opened, frequently fractures a rib in human beings. The steep, oblique descent of the ribs in the human subject and the extreme narrowness of the interspaces are responsible for this accident. It is expected that such fracture will be avoided by curving the patient's thorax over a pillow, or by raising the cross-bar attachment to the special operating table (Fig. 9), which latter is the result of the joint efforts of myself, my brother, and the Kny-Scheerer Co., who built the table for me.

2. In doing this operation, it is necessary to expose the nervus vagus above and below on either side of the affected portion of the œsophagus. This is to be the *very first step* after having gained entrance to the thoracic cavity and having pushed the lung aside. If both pneumogastrics have become involved, the operation should be broken off; if one only is found to be invaded by and inseparably connected with the tumor, it may be cut. Further physiologic experimental work will be welcome to show the surgeon whether and where he may safely cut one of the pneumogastrics within the thorax, and also if there be any difference, whether the one to the right or the one to the left of the œsophagus be divided.

3. The only hope of helping patients with œsophageal carcinoma lies in *early operation*. Exploratory thoracotomy should be done as soon as the first signs pointing to a malignant stricture appear. Not infrequently it will be possible to corroborate the diagnosis even then by the X-rays (bismuth paste), œsophagoscopy, and microscopical examination of a small particle of the growth extracted on that occasion.

It *should be* remembered that the diagnosis of carcinoma

of the œsophagus is not difficult, that the tumor is clinically the most benign of all carcinomas from the mouth to the rectum. Yet it should also be borne in mind that every patient, not operated upon, is absolutely lost, within an average of fifteen months.

At present, the mortality of resection of the œsophagus is still 100 per cent.

It is to be hoped that the feasibility of successful operation in these cases will soon be demonstrated, so that patients may be induced to submit to early operation.

A review of the literature shows that carcinoma of the œsophagus has been the cause of intrathoracic operations not less than 34 times. The exact number of cases cannot be stated, because full reports of the last Surgical Congress at Berlin, April, 1910, have not yet reached us.

As nearly as I could make out, resection of the œsophagus in the human being has been reported 21 times, by seven European surgeons, viz.: Mikulicz, 3; Sauerbruch, 4; Tuffier, 1; Küttner, 6; Wendel, 5; Tiegel, 1; Kümmel, 1. Œsophagogastrostomy, with the button, leaving the tumor in place, 1 (Sauerbruch). Thoracotomy was done 6 times with the intention of resecting the œsophageal neoplasm; local conditions, however, forbade radical work, the thoracotomy thus remaining an exploratory one. To these operations are to be added my 4 cases described above, *i.e.*, 3 exploratory thoracotomies and 1 resection for œsophageal cancer, making a total of 21 resections; 1 palliative operation and 9 exploratory thoracotomies. Sauerbruch mentions 7 further cases of his own, without giving details as to whether resection or exploratory operation only was done. Total number of operations, 39.

Of the cases in which exploratory thoracotomy was done, all recovered. The œsophagogastrostomy case (button) died. Of the resected cases none recovered.

I have tried to analyze the causes of the fatal issue in my own case of resection of the œsophagus.

As in other major operations, death in these cases may be due to (1) general anæsthesia, (2) hemorrhage, (3) lack of asepsis, (4) shock.

1. General anæsthesia, in my case, was in the hands of an expert; nitrous oxide plus oxygen was used, the least detrimental of all narcotics so far known; during the last one and one-half hours of the operation pure oxygen was administered. The deleterious effect of the anæsthetic, as such, can therefore be excluded.

2. Hemorrhage: There was no hemorrhage whatever; a slight arterial oozing, when loosening the lower portion of the infiltrated œsophagus from its bed, could be nicely controlled by temporary compression with a gauze tampon.

3. Faulty asepsis: No mistake occurred; besides the effect of any such neglect could not have been immediate.

4. Shock is the only possible cause remaining.

I believe that the so-called shock in these operations is of twofold origin:

a. Interference through blunt manipulation with the system of the pneumogastric nerves and their manifold anastomoses with the sympathetic plexuses.

b. Accumulation in the blood of carbon dioxide, no matter in what manner differential pressure be applied.

Both these factors induce the so-called "vagus pulse." Verworn succeeded as early as 1892 in asphyxiating an animal by CO_2 retention while it was breathing pure oxygen. The true inwardness of this surprising fact was brought out later by Volhard's instructive paper. He was endeavoring to find out whether curarized dogs could be kept alive by continuous gentle insufflation of pure oxygen through a narrow rubber tube into the trachea, with free escape of the oxygen around the tube to open air. The thorax was left closed. Animals were kept alive in this way for from 1 to 2 hours; they finally died of CO_2 retention. He found that oxygen was drawn into the alveoli by a suction corresponding to 15 mm. Hg negative pressure. If only this want was supplied, the animals would die in about ten minutes. But by a more rapid flow of the oxygen the CO_2 retention was diminished and the animals would remain alive an hour or more. The use of air in place of oxygen resulted in rapid death of the animals of CO_2 retention, because only one-fifth of the air is oxygen, so that after its absorption there remains space for each subse-

quent tidal inflow of only one-fifth of the preceding one. Volhard did not increase the pressure in the lung.

In differential-pressure operations CO_2 retention also seems to occur. Sauerbruch and Küttner state that in case of weakness of the heart in the course of an intrathoracic operation, sudden increases of pressure have been found a most effective help. Petersen found lung gymnastics a heart stimulant. Volhard's experiments explain the cause of this observation. The so-called shock in these cases is evidently partly due to an accumulation of carbon dioxide in the blood. In an exploratory thoracotomy of short duration such retention of the noxious gas is not sufficient to do injury. But in the longer operations, for instance the resection of the œsophagus, the greater CO_2 accumulation and the added effect of the necessary blunt handling of the network of the pneumogastrics, both acting cumulatively in the same direction, is too great a strain upon the heart, and it gives out. This has been my observation also in the two cases of partial pneumectomy, above cited. When ligating the many vessels along the bronchus, undoubtedly one or more branches of the pneumogastric of the lobe of the lung became included in the ligature. Everything having gone fairly well up to that moment, a sudden turn occurred; the heart, already weakened by the slowly increasing cumulative action of the carbon dioxide, received its death-blow through the added nerve reflexes.

A very important conclusion can be drawn from these experiences. It is necessary in the course of thoracic operations of long duration to interrupt now and then the pressure, allowing the lungs to collapse; in other words, to interpose at regular intervals brief periods of artificial respiration by means of the apparatus, in order to clear the system of its CO_2 accumulation. It will be best to do that *before* any alteration of the pulse has been noted by the narcotizer or by the assistant on the outside of the apparatus, detailed to watch the pulse at the wrist or at the foot.

It is not quite correct to call this procedure artificial respiration, because the patient keeps on breathing spontaneously.

Slow rhythmic changes of pressure are made and the patient is merely forced to breathe from varying levels of pressure. At the same time the open side of the lung rises and falls with the pressure.

To avoid weakness of the heart, the surgeon should further do his utmost to handle the pneumogastrics as gently as possible, also cocainize one of the two nerves. A hypodermic of $\frac{1}{60}$ grain of atropine before, and, without fail, about one hour after the beginning of the operation; further, an intravenous infusion with 10-20 minims of adrenalin will be found helpful aids.* In cases of emergency direct massage of the heart, the operator taking hold of the organ with his hand, may be of great assistance.

After the completion of the intrathoracic work, if the pulse remains weak, it will be unwise to close the chest and then remove the patient from the pressure chamber, leaving him to his own resources at a moment when he should receive the utmost assistance. Rather should rhythmic pressure by means of the apparatus be continued with the thorax open, until the heart has recuperated.

What can be done for the heart in that way I had brought home to me in recent experiments on curarized dogs. Using my positive differential pressure apparatus, a curarized narcotized dog was kept alive by means of artificial respiration, performed with that apparatus, for upward of one hour and,

* On May 31, I had occasion to test the suggestions made above, in a greatly reduced female patient with cardiospasm of 16 years' standing, necessitating gastrostomy. Sounds could not be made to pass the cardia; there was a large œsophageal pouch above the diaphragm. Thoracotomy proved the diagnosis to be correct. A double "œsophagoplication" was done, in order to reduce the diameter of the pouch, and the thorax closed. Rhythmic pressure was applied for several minutes at intervals of $\frac{1}{4}$ hour during the course of the operation; toward the end, it was applied continuously. An intravenous infusion of saline with adrenalin was also given. Patient stood the operation nicely. At present, three weeks later, the patient is again able to swallow solids without any regurgitation, and feeding through the gastric fistula is no longer necessary. She is gaining flesh steadily. An exploratory thoracotomy for a tightly stricturing epithelioma of the œsophagus, done on June 29, was rendered by means of these brief rhythmic pressure changes at regular intervals as smooth and satisfactory as any of our daily operations in other parts of the body.

time permitting, could have been kept alive indefinitely. The differential pressure was then turned off for four minutes, so that the dog was under acute pneumothorax during all that time, and, with subsequent artificial respiration by means of the apparatus, the heart was promptly restored to proper action.

In the second experiment, artificial respiration was made while operating under negative pressure, the valve of the large negative chamber being opened and closed in the same way as that of the positive chamber in the first experiment. The curarized narcotized dog was subjected to double pneumothorax for three minutes. At the end of the first minute the heart became very weak; it stopped beating altogether within a little less than $1\frac{1}{2}$ minutes. I waited another $1\frac{1}{2}$ minutes; then began artificial respiration with my apparatus at the rate of two complete respirations per minute and, after a very little while, the heart beat again 120 per minute with a full pulse. It seemed to be of benefit for the restoration of the heart's action to run up the pressure higher than required for ordinary differential pressure purposes, viz., 10 mm. Hg. Under this pressure every part of the lung became fully inflated and pink.

In both experiments the glottis became obstructed by the collapse under curare of the paralyzed laryngeal muscles. A short rubber tube was quickly introduced into the glottis to hold it open, and, with it in position, the animals were revived as described above.

In operations on human beings, when making rhythmic pressure, the surgeon can tell by the action of the lungs whether the glottis is open. The lung rises and falls with the changes in pressure. If this does not occur, although the epiglottis has been properly raised, closure of the glottis must be the cause. Experience will show whether in thoracic operations on human beings closure of the glottis is an occurrence that has to be reckoned with. In that event, the narcotizer should be provided with an O'Dwyer tube.⁷ So far, no mention of this subject has been made in the literature.

⁷ This is another reason for having two men inside of the positive differential pressure apparatus for the conducting of the anæsthesia.

Rhythmic pressure at the end of the thoracic work and before closing the thorax is advisable for still another reason: the tampons that had to be placed for maintaining asepsis compress the lung on the opened side; in this way a kind of pneumothorax is produced that might be called "mechanical pneumothorax," the other lung meanwhile doing most of the work. To some extent the bad features of acute pneumothorax must make themselves felt, principally the bulging of the mediastinum towards the closed side. The resulting CO_2 accumulation is eliminated by the rhythmic pressure.

In conclusion I would say that the road into the thoracic field is rough and stony, strewn with many depressing disappointments. Still, the work is so fascinating and there are also so many inspiring experiences that I have no doubt thoracic surgery will soon become a favorite branch of our science and form an integral part of the routine work of our hospitals.

IV. APPARATUS.

Thoracic surgery should be done at the hospital, not only for the sake of asepsis, but also on account of the strong artificial light needed for the work in the depth of the thorax. Only in such emergency cases in which the removal of the patient to the hospital would clearly jeopardize his life should intrathoracic work be done at his home; electric reflectors would then have to be carried along.

Hospitals will do well to secure one of the available differential pressure chambers or cabinets. They simplify the work, are always ready for use, meet every emergency, can be easily called into action in the course of an operation, can be used for after-treatment without inconveniencing the patient and without employing general anæsthesia.

While the differential pressure apparatuses may, at the first glance, appear complicated to the uninitiated, and are certainly rather expensive, they are in reality simple to manipulate. The manner of their construction and the reserves in the machinery of the apparatus of improved type, make intrathoracic work as safe as intra-abdominal work; they make the surgeon forget that he is working within the thorax. From

my point of view no apparatus is too good or too expensive for hospital use, if it has corresponding advantages.

The installation of a differential pressure chamber or cabinet at hospitals need, of course, not exclude the use of other differential pressure methods with their necessary apparatus.

V. OPERATING TABLES AND INSTRUMENTS.

It has been found desirable, when employing the apparatus I myself use, to have a special operating table which permits of moving the patient vertically and placing him at any time in Trendelenburg's posture. Figs. 9 and 10 show this table now in use at the German Hospital; the hinge, as will be seen, is at the place of the patient's neck.

When operating with the help of the large skin muscle flap, required in all operations in the upper part of the thorax, where the scapula will be found in the way, a table is preferable which permits of turning the patient also around his longitudinal axis. This type of table is now in course of construction.

Regarding instruments, Friedrich's rib-spreader (Fig. 11, 1 and 1a) has been found sufficient in the majority of cases. When resecting the œsophagus we have tried to get along with the instruments used in abdominal surgery. A bayonet clamp (Fig. 11, 2) and the improved Doyen crusher⁸ (Fig. 11, 3) are indispensable when doing pneumectomy. The large, curved intestinal clamps, their branches ensheathed in rubber tubes, are useful in resections of the lung (Fig. 11, 4). For handling the diaphragm, I have had special forceps constructed, which allow one to grasp the diaphragmatic muscular fibres, including the phrenic peritoneal cover, at right angles to the former, thus preventing a tear. They have been found useful in animal experimentation, when suturing the border of the rent, bluntly made through the diaphragm alongside the cardia, to the stomach, which had been pulled into the thorax for anastomosis with the resected œsophagus (Fig. 11, 5). The improved "Kuester's swan"⁹ (Fig. 11, 6) is *the* needle holder for placing deep sutures.

⁸ Made for me by Klöpfer of Bern.

⁹ New York Medical Record, 1905, lxviii, 569.

ARTIFICIAL RESPIRATION AND INTRATHORACIC ŒSOPHAGEAL SURGERY.

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At the 1909 meeting of the American Medical Association we presented a paper on intrathoracic experimental surgery,¹ and we then described a new apparatus for performing operations under positive pressure and also a button for facilitating intrathoracic œsophageal anastomoses. Both the cabinet and button have been improved since that time, and our added experience with these warrants a more detailed description of each.

One of the new features in the cabinet has been the outgrowth of the previous work of one of us (N.W.G.).² In working with the intralaryngeal canula it was noticed that the alternating increase and decrease in intratracheal pressure produced an artificial apnoea which largely eliminated the movements of the diaphragm. The advantages of such an elimination of movement during operation were so apparent that it induced the other of us (H. H. J.), whose previous work had been done entirely with the negative and positive pressure cabinets,³ to devise another cabinet provided with a mechanism which accomplished during operation a similar cessation of respiratory movements.¹

Figs. 1 and 2 illustrate the improved cabinet which we wish herein to describe.*

* The cabinet has been made for us by Charles E. Dressler, of New York.

FIG. 1.

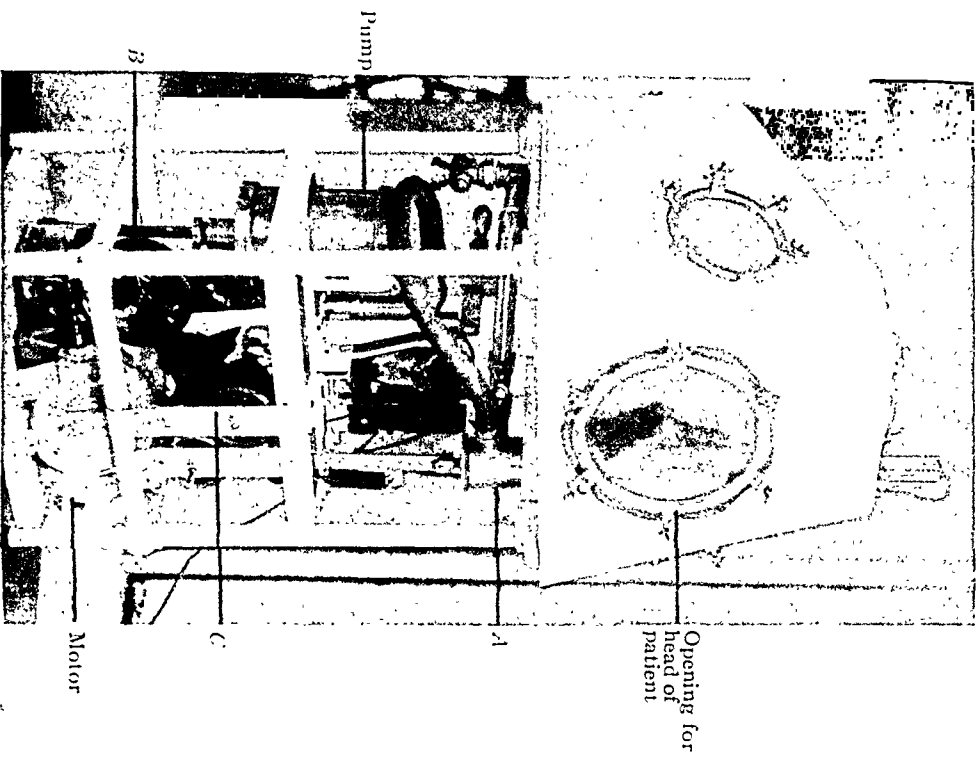


FIG. 2.

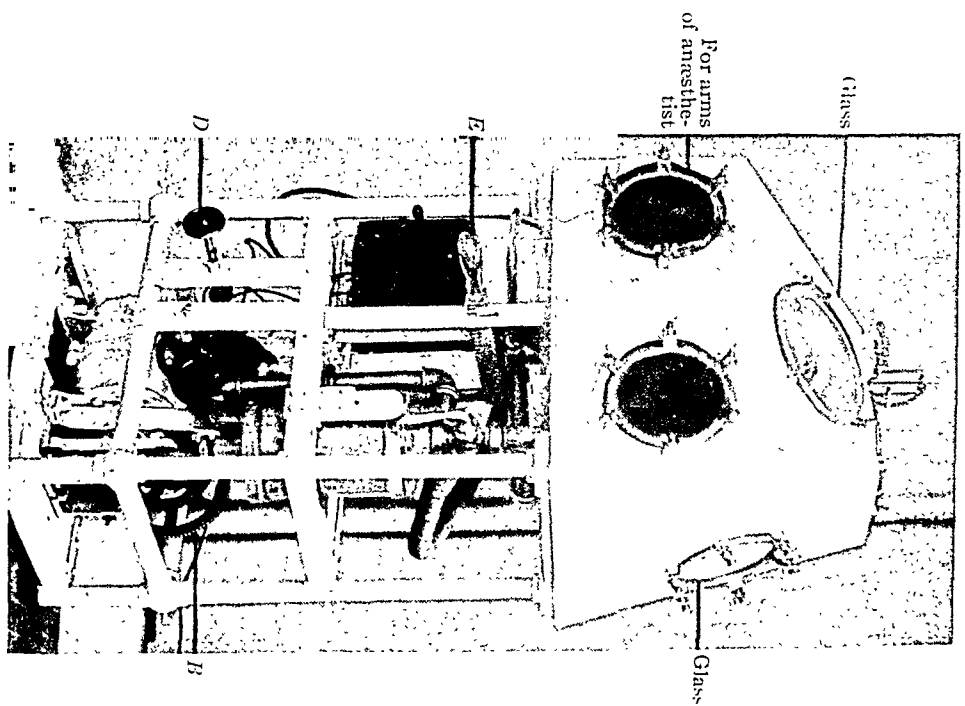
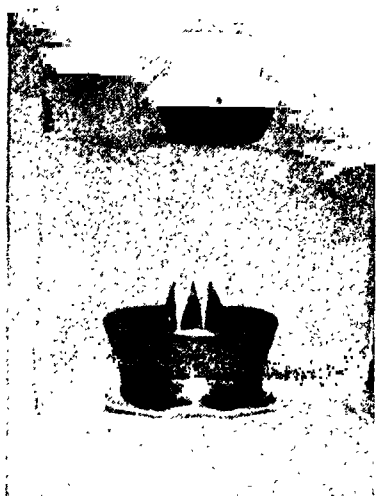


FIG. 4.



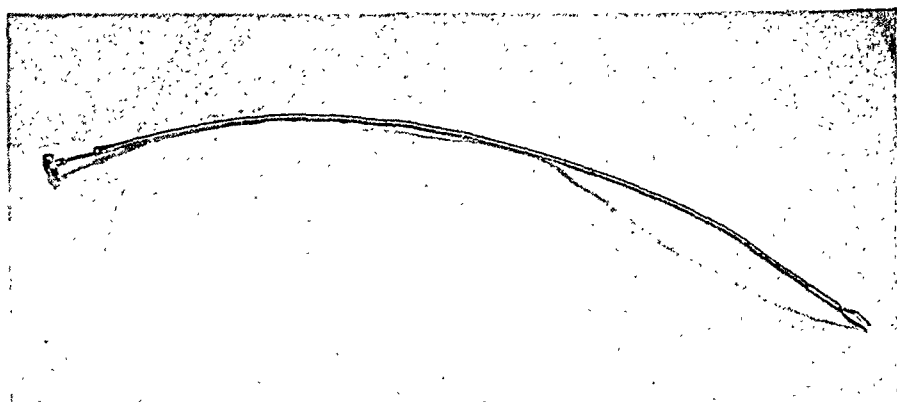
Button for end-to-side anastomosis.

FIG. 3.



Button for lateral anastomosis.

FIG. 5.



Holder for introducing button in lateral anastomosis.

FIG. 6.



Forceps for holding button in end-to-side anastomosis.

The important features of this cabinet are: first, its compactness and hence its greater portability than the larger negative or positive chambers; second, the inclusion of both the pump and motor in the space beneath the box; third, the ease and rapidity with which the patient's head can be introduced; and, fourth, the addition of the valve mechanism (*A*) permitting of a rhythmical rise and fall of pressure within the cabinet. This valve is so controlled by change speed gears (*B*) and a cone-shaped cam (*C*) that, not only a wide range in frequency of artificial respirations can be obtained but, also, the ratio of the duration of inspiration to expiration can be varied at will. Such a cabinet, therefore, permits a true artificial respiration independent of the efforts of the patient. Respiration may be uninterruptedly continued with the use of such an apparatus even though the patient be suffering from respiratory embarrassment whatever the cause, whether from an overdose of ether, or from morphine or gas poisoning, or from suffocation by smoke. By this apparatus we have kept a fully curarized dog alive for four hours.

The apparatus, also, permits of the perfect control of the head of the patient by the anæsthetist in case of vomiting or the necessity of cleaning out the pharynx or passing an instrument into the œsophagus or stomach.

By the lever (*D*) used to vary the rate of respiration and the lever (*E*) which varies the ratio of the duration of inspiration to expiration the movements of the diaphragm are under control. We consider this to be an important factor contributing to the success of intrathoracic operations. We know of no form of apparatus which combines in this way the advantages of the larger cabinets and direct insufflation.

The pioneer work of Sauerbruch in thoracic surgery has stimulated renewed interest in artificial respiration. Within only a few years rather numerous forms of apparatus for this purpose have been devised. In general, they may be divided into four classes. First, the negative or positive pressure chambers (Sauerbruch ^{4, 5}, Willy Meyer ^{6, 7}; second, the positive pressure cabinets (Brauer ^{8, 9}, Murphy, ¹⁰, Janeway and

Green¹; third, the positive pressure masks (Robinson^{11, 12}, Tiegel¹³; and fourth, the various devices for direct insufflation through the trachea (Fell,¹⁴ Fell-O'Dwyer,¹⁵ Doyen,¹⁶ Matas,¹⁷ Green,² Volhard,¹⁸ and Meltzer¹⁹). Only extended trial upon the human subject will decide which of these various forms of apparatus is best adapted to general use; and probably for a long time in the future they will all be continued to be used according to the preference of this or that surgeon. We desire, therefore, to state our reasons for preferring the one herein described.

As opposed to the negative pressure chambers we can see no difference whatever between negative or positive pressure. Neither do we believe that any advantage will ever accrue to the use of differential pressures of definite heights, in place of utilizing the normal atmospheric pressure for one of the two pressures in any operation conducted under differential conditions. Our own experiments do not confirm the observations of Robinson and Sauerbruch (*Deut. Ztschr. f. Chir.*, 1909, cii, 542; and *ANNALS OF SURG.*, 1910, li, 320). Since these publications have appeared one of us (H. H. J.) has removed the whole lung of one side from a consecutive series of five dogs, and each one has made an uninterrupted recovery.

The elaborate apparatus constructed by Willy Meyer will furnish further evidence upon the relative merits of positive and negative pressure. While complicated, it after all surrounds the patient with the simplest conditions, and as a result of our personal experience through the invitation of Dr. Meyer we believe that the mechanism is perfect and furnishes to the operator and the anæsthetist every convenience. While believing it to be an ideal apparatus, nevertheless the adaptability to easy transportation of the smaller positive pressure cabinets often amounts to more than a mere convenience. The valve mechanism permitting the rhythmic rise and fall of pressure within the cabinet is an important addition, and, we believe, is more perfectly adapted to cabinets of small size than to the larger rooms.

The objection to the use of the third class of apparatus

for artificial respiration consists in the fact that access to the mouth and pharynx is greatly impeded by them.

Concerning the fourth method of artificial respiration our judgment is yet in abeyance. The method is the oldest form of artificial respiration. It was used as early as 1829 by Monroe, Goodwin, Hunter, North and John Murray (quoted from Matas). On account of accidents depending upon excessive pressure of air within the lungs the method fell into disuse. Dr. Fell of Buffalo deserves the credit of again using the method and of being the first man to demonstrate its real value. Too much credit cannot be given to Dr. Fell for his persistent efforts and successful pioneer attempts in perfecting an apparatus for artificial respiration by insufflation of air through the trachea.

The instruments of Doyen, Matas and that formerly employed by one of us represent attempts at further improvement of virtually the same method. A greater variation attempted by Volhard, two years ago, is the continuous insufflation of oxygen through an intratracheal tube.

Robinson¹¹ repeated Volhard's experiments, and going a step further tested artificial respiration by continuous insufflation of the trachea with air, instead of oxygen, in exactly the same manner that Meltzer has now adopted.

Meltzer, however, deserves the credit of further perfecting this method and of demonstrating that in it we have a valuable means of artificial respiration for thoracic surgery.

We consider this method the best improvement of all those of the fourth class. Its success, we believe, depends upon the fact that when a soft rubber tube of a certain size is introduced far enough within the trachea there is some resistance offered to the air passing out of the trachea around the tube. The failure to recognize this fact undoubtedly explains why this method has never been used before. We believe as a result of our own work that the amount of distention of the lung present when the Meltzer apparatus is used proves that there is present an intratracheal positive pressure of at least 5 mm. The respiratory movements of the animal do not

cease, unless the pressure is raised to a definite height, and when only one side of the thorax is opened, due to the weight of the chest walls, the lungs are alternately filled and emptied of air. Meltzer encourages this and advises the complete exhaustion of air from his system of tubes two to five times a minute. We believe, however, that when both sides of the chest are opened or the animal be suffering from morphine poisoning, that it will be desirable to increase the frequency of this exhaustion. The method, therefore, must be viewed as a true positive pressure method and is surely more than its name "continuous insufflation" indicates. As Willy Meyer has emphasized, the method, though seemingly simple, really affords to the patient more complicated conditions than when the pressure cabinets are used. This is true for the simple reason that the cabinets, particularly if supplied with the mechanism for alternately increasing and decreasing the pressure of air within them, can accomplish all that Meltzer's method does and can do it without the additional factor of the presence of a tube within the trachea. We do not, however, wish to state that this addition should be considered an objectionable one unless it shall be demonstrated to be injurious.

Through the kindness of Dr. Meltzer we have used his method with his own apparatus in his laboratory and our experience with it on this occasion was most satisfactory. The operation, which was a long one, passed off as smoothly as any that we have ever performed. During the operation we filled the mouth of the animal with a suspension of charcoal in water. None of this solution was drawn into the trachea. This single observation, therefore, confirms Dr. Meltzer's experience that the return current of air prevents the inhalation of fluids from the mouth. The small size and the inexpensiveness of his apparatus are important considerations favoring the adoption of his method. Nevertheless, for the present at least, we prefer our cabinet for the following reasons. In the first place, the true status of any form of artificial respiration is not yet established. Though not so easily portable nor so cheap as

intratracheal tubes, our positive pressure cabinet can be, nevertheless, easily transported. Otherwise it possesses all the advantages of warming the inspired air, diluting the ether vapor, ease of application, control of the patient's head, and possibility of inducing respiration independent of the efforts of the patient, that cannot be claimed for any other method. By its use there is also more uniformity and gradualness in the variations of air pressure than is the case with direct intratracheal insufflation; nor is the ether blown so directly into the lungs. We believe also that our cabinet permits of the absorption by the patient of less ether. For two reasons this is true. First, when the head of a patient is surrounded by a positive pressure there exists a certain degree of cerebral anæmia which in turn renders less ether necessary for surgical narcosis. Sauerbruch^{20, 21} has even made use of this fact in controlling hemorrhage in cerebral operations. Again, the mere fact that the patient is so completely artificially respired with air mixed with ether vapor renders it an extremely difficult matter to give the minimum amount of ether required. In our experience with intralaryngeal insufflation what would have been otherwise a toxic dose has frequently been absorbed by the animal. In this connection it is necessary to distinguish between the amount of ether used during an operation and the amount actually absorbed. Less may be used and yet more absorbed. We judged of the amount absorbed by the effects upon the animal after stopping artificial respiration. These factors are perhaps not of paramount importance, but in any surgery it is desirable to take advantage of every means contributing to the interest of the patient.

Finally, there is some place for an apparatus for artificial respiration which can be quickly used by those unskilled in passing tubes within the trachea or by nurses. Fire departments should be supplied with such a form. Nothing could be more easy in its application than the slipping of a rubber collar over the neck of the patient, the head of the patient when so incased remaining completely under the control of the attendant.

Fig. 3 illustrates the modification of the button described by one of us (N.W.G.) before the American Medical Association in 1908²⁰ and has proved of definite value in the lateral anastomosis of the stomach with the œsophagus. By the pressing together of the opposing halves of the button through the approximated and unopened walls of the œsophagus and stomach a union of these viscera is effected without the slightest contamination of the field of operation, and more rapidly than it can be done by any other method. By the use of this button we have shortened the operation by at least half an hour. Surely when operating in such a cavity as the pleural cavity where inflammatory processes can originate from much less exposure than within the abdomen, such a gain in time must be considered an important factor.

Fig. 4 illustrates another modification of the same button that has been designed by the other of us (H.H.J.) for the union of the resected end of the œsophagus and the lateral wall of the stomach. It makes possible an end-to-side anastomosis through the closed viscera without the exposure of an infected surface. A purse-string suture passed around the œsophagus is pulled tight, the œsophagus is then divided distally to the ligature and the stump placed between the needle points. The male half is then approximated through the wall of the closed stomach and the two halves pressed together. The needles and blade penetrate and engage the thread of the male half.

Until recently we had had our only successful cases of typical gastro-œsophageal resections within the thorax by the use of this button, and no successful cases where the anastomoses had been accomplished by suture. We attributed this fact, at that time, to the aseptic manner in which the anastomosis had been performed, and felt confirmed in our opinion by the experience of Sauerbruch^{22 23 24} and Tiegel.²⁵ Lately, however, a number of considerations have influenced us to try the suture method again. In the first place, upon a number of occasions the button has slipped from its holder during the pressing of the two halves together. Again, it is important

for the button to be adapted in size to the particular animal upon which it is used, and finally, the needles and blade must be very sharp. Though these elements are always under control, yet we have felt that any satisfactory instrument should have more latitude in the conditions permitting its successful use. These considerations, and the fact that our latest experience with the suture has been more favorable, have influenced us to doubt the advantage of the use of a button for the union of the œsophagus with the stomach after a resection of a portion of both these organs. The objections above mentioned do not apply to the use of the button for a lateral anastomosis. Its use for this purpose is a decided gain and has transformed such an operation in our hands into a, comparatively speaking, safe procedure. In the operation for resection, however, the choice between the needle and thread and the button may be still debatable.

By a special technic developed by one of us (H.H.J.) we have been able to resect one to one and one-half inches of the œsophagus and all of the stomach but the pylorus. We now have (February, 1910) three perfect recoveries out of five operations of this kind. In all the needle and thread has been used to accomplish the anastomosis. We believe, therefore, that this operation will have a definite field of usefulness. Our experience in œsophagoscopy leads us to believe that a large proportion of œsophageal strictures begin in the stomach or just at the cardiac sphincter, and that in many the stomach is the most important viscus involved.

Only through the thorax can successful approach be obtained to the cardiac end of the stomach and distal end of the œsophagus; and an operation which permits of successful removal of some of the œsophagus and a large portion of the stomach must have a definite utility.

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CANCER OF THE ŒSOPHAGUS AND CARDIA.*

A DESCRIPTION OF AN OPERATION FOR ITS REMOVAL BY THE TRANSTHORACIC
ROUTE UNDER CONDITIONS OF DIFFERENTIAL PRESSURE.

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THE development of the Sauerbruch idea, rendering accessible to surgical attack the interior of the thorax, led to the hope that carcinoma of the lower portion of the œsophagus would be soon amenable to radical removal. The fatal issue, however, of the few operations of this character which have been undertaken, and the rather indifferent results of animal experimentation have somewhat cooled the interest in this province of surgery. Nevertheless the field is an important one, for carcinoma of this region is by no means of infrequent occurrence. There are to be considered not only the strictly œsophageal tumors but also cancer of the proximal portion of the stomach. The contiguous parts of these two organs, anatomically different, form one surgical region. Rokitansky¹ first formulated the rule that the duodenal walls do not become involved in cancer of the pylorus, while cancer of the cardiac portion of the stomach regularly extends to the œsophagus. For cancer of the pylorus, Lebert² found only one exception to this rule in 34 autopsies, and Brinton³ ten in 125. Few exceptions also exist at the cardia for the converse of the conditions at the pylorus. Fenwick⁴ and Robson⁵ comment on the frequency with which cancer of the oral portion of the stomach invades the œsophagus. Fawcett,⁶ out of 36 cases of malignant disease of the stomach

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occurring between the years 1826 and 1900, found 26 cases in which the cardiac orifice was involved. Of these one was a sarcoma, and, of the remaining 25, 16 had invaded the œsophagus for some distance. In all the 25 cases the stomach walls were the seat of the disease for a distance of three or four inches.

It is, therefore, a matter of interest to estimate the general frequency of œsophageal and gastric cancers, and to know what proportion of these growths in the case of each organ is situated at or near the cardia. With this end in view the accompanying tables have been constructed.

GENERAL FREQUENCY OF CÆSOPHAGEAL CANCER.

Albrecht⁷ from the Obushow Hospital records between 1873 and 1877, found 27 œsophageal cancers.

Krusenstern⁷ from the Obushow Hospital records between 1873 and 1883, found 44 œsophageal cancers.

Stroganow⁷ from the Odessa Hospital records between 1877 and 1887, found 44 œsophageal cancers.

Von Hacker⁷ from the Billroth Clinic records between 1877 and 1886, found 131 œsophageal cancers.

Cölle⁷ in Göttingen, 1877 to 1886, found 17 œsophageal cancers among 1650 patients.

Rebitzer⁷ in Munich, 1854 to 1889, found 29 œsophageal cancers from 15,168 autopsies.

Ludewig⁸ in Göttingen, 1898 to 1905, found 48 œsophageal cancers from 9339 patients.

RELATIVE FREQUENCY OF CANCER OF STOMACH AND CÆSOPHAGUS

	Stomach	Liver and gall-bladder	Uterus	Breast	Rectum or rectum and intest.	Æsophagus	Total number of cancers or individuals
Borstell ⁽⁷⁾	32.5%	.....	14.7%	.....	.....	5.9%	217 cancer cases.
Aschoff ⁽⁹⁾	1571	464	580	252	418 incl. intest.	217 (4.79%)	4574 cancer cases.
Frief ⁽¹⁰⁾	2147	757	.....	.....	407 incl. intest.	359	
Feilchenfelds ⁽¹¹⁾							
(1901).....	165	.....	45	.....	56 incl. intest.	58	
Reichelmann ⁽¹²⁾							
(1902).....	288	.....	105	1	140 incl. intest.	77 (10.8%)	711 cancer cases.
Bashford ⁽¹³⁾	14,468	11,531	11,714	8428	6389	2833 (3.35%)	84,448 cancer patients for 3 yrs. '01-'03 in England and Wales. (2086 cancers of tongue.)
Prinzling ¹⁴ (1907).	3.15	1.66	2.5	.9	.....	3.125	To each 10,000 inhab.
Redlich ¹⁵ (1907)...	176	38	52	27	59 incl. intest.	55 (11%)	496 cases.
McConnell ¹⁶ (1908)	33.7%	13.5%	27.6%	15.7%	44.7%	.....	To each 100 deaths from cancer.

DISTRIBUTION OF ŒSOPHAGEAL CANCER

	Year	At beginning of Œsophagus	At bifurcation of trachea	At cardia
Habershon ⁷	1857	33	30	10
Petri ⁷	1867	2	13	8
MacKenzie ⁷	1875	44	28	22
Zenker and v. Ziemssen ⁷	1878	2	1	6
Krusenstern ⁷	1885	3	30	14
Morosow ⁷	1887	10	18	61
Morosow (prep.) ⁷	1887	3	2	4
Cölle ⁷	1887	15	63	84
Johansen ⁷	1888	29	47	82
Voight ⁷.....	....	4	17	41
v. Hacker ⁷.....	....	13	53	65
Wright ¹⁷.....	....	36	48	35
Pigge ¹⁸	1899	3	12	10
Mampell ¹⁹	{ 1889-1904	*6	14	30
		†7	29	37
		*1	46	60
		†6	12	110
Hampeln ²⁰	1905	26	43	117
Sauerbruch ²¹	1905	3	16	23
Ludewig ⁸	1908	10	5	28
Slavyanis ²²				
		256 (15%)	527 (32%)	847 (52%)

* Autopsy. † Klin. cases.

DISTRIBUTION OF CANCER OF THE STOMACH

	Pylorus	Cardia	Lesser curvature	Rest of stomach
Brinton ⁵ (1865).....	219	36		105
Gussenbauer and Winiwarter ²³ (1876).....	542	58	65	209
Lebert ²⁴ (1878).....	10	5		1
Welch ²⁵ (1900).....	791	104	148	257
Osler and McCrae ²⁶ (1900).....	27	3		18
Fenwick ⁴ (1902).....	173	24	29	39
Colwell ²⁷ (1906).....	149	19		59
Makkas ²⁸ (1907).....	134		18	24
Daniel ²⁹ (1908).....	225	4	61	26
	2270 (63%)	253 (7.6%)*	321 (8.9%)*	738 (23%)

* Total number of cases occurring in the cardia and lesser curvature equals 16 per cent.

A review of these tables will justify the conclusion that cancer of the stomach forms from 20 to 30 per cent. of all cancers, and that of this proportion 16 per cent. belong to the cardia and lesser curvature and 7 per cent. to the cardia alone. Taking the figures of Bashford¹³ to be the most accurate as a basis for calculation, we would have 2387 carcinomas of the cardia and lesser curvature, and 1099 of the cardia alone among 84,448 cancer cases occurring in England and Wales between the years 1901 and 1903. If we now add

to these numbers 52 per cent. of all œsophageal tumors (1472) we will have from 2570 to 3859 tumors situated at or near the cardiac orifice of the stomach for the same period—a number in either case greater than Bashford's statistics for carcinoma of the tongue and nearly equal (in its upper limits) to 50 per cent. of the number of cancers of the breast, a notoriously frequent form of carcinoma. One source of error may exist in the above method of calculation. It is possible that in the table showing the distribution of cancer of the œsophagus, a number of gastric growths may be included. Admittedly, for an absolutely correct calculation only such series of cases should be used which include both tumors of the œsophagus and stomach, and are at the same time coupled with a pathological report. Of 30 specimens of malignant disease from all portions of the œsophagus, Perry and Shaw³⁰ found that every one, with the exception of two sarcomas, was a squamous cell epithelioma, while of 44 gastric carcinomas, of which three involved the cardiac orifice, 12 were cylindrical celled carcinomas and 32 were spheroidal celled carcinomas. Haberkaut³¹ makes the following classification of 88 gastric cancers: scirrhus 32, adenocarcinoma 20, medullary carcinoma 18, "gallert" carcinoma 18. In the Matti series scirrhus carcinoma is very rare. Of the cases numbered from 53 to 97 cylindrical celled carcinoma occurred 12 times, carcinoma simplex 5, carcinoma colloides 5 times, and carcinoma medullare once, scirrhus 1, and mixed forms 12 times. There were no epitheliomas. It is excessively rare to find carcinoma as distinguished from epithelioma originating in the œsophagus. Franke³² has reported one case and refers to two others as curiosities.

We have used, however, the only data which we have been able to find, and such as they are we believe that they indicate a fair approximation to the truth. They at least clearly demonstrate the surgical importance of the cardia, and justify a serious effort in attempting to remove growths in this situation.

A number of considerations render carcinoma of the stom-

ach peculiarly suitable for radical attack if only the technical difficulties of the operation and of the early diagnosis can be overcome.

Gussenbauer and Winiwarter,²³ on the basis of the autopsy material of the Vienna Pathological Institute between the years 1817 and 1873, found 223 instances out of 542 pyloric carcinomas in which the tumors were well isolated, and of these 172 had scarcely any extensions to the surrounding organs; 41.1 per cent. of operated cases were stated to be free from metastases and 37.7 per cent. possessed no external growth. Ledderhose,³³ of 39 cases from the autopsy material of the Strassburg Pathological Institute, found 10 per cent. of such cases. Streit,³⁴ between the years 1876 and 1886 of the autopsy material of the Bern Pathological Institute, found 25.9 per cent. of these cases. Rydygier,³⁵ agreeing rather with the results of Ledderhose, found of 52 operated cases only 9.6 per cent. without extension beyond the stomach. Kramer,³⁶ of 66 cases operated upon, found 26 with extensive external growths and calculated that 33.3 per cent. are operable. Haberkaut,³¹ of 59 cases operated upon, found 20 with no external extension. Makkas²⁸ found no enlarged glands in 14 cases out of 167, and, out of the same number, in 46 only was there extension to neighboring organs. The table on page 73 shows the proportion of resections performed by the various operators and indicates the proportion of operable tumors of the stomach. It also shows the increasing number of permanent cures.

These results are the more remarkable when we remember the comparatively late period at which many patients submit to operations. In practically 90 per cent. of the cases a diagnosis is not reached until a tumor or resistance can be felt through the anterior abdominal walls. Out of 167 cases reported by Makkas,²⁸ there were only 10 in which no tumor or resistance could be felt. Of the Matti⁵⁰ series, a tumor existed in 77.3 per cent. and a resistance in 8.2 per cent. Of 50 resected cases reported by Creites,⁴⁰ only 3 came for treat-

ment inside of the first three months. Only eight presented themselves before six months from their first symptoms, and 39 submitted to operation between six months and one year, and 10 between $1\frac{1}{2}$ years and 6 years. Of 665 cases reported by Hoffman,⁵¹ 25 were operated upon inside of the first two months, of which 4 were resected, 117 inside of three months, of which 24 were resected, 187 between three and six months, of which 53 were resected, 303 at six months, of which 77 were resected, 193 between six months and one year, of which 58 were resected, 144 after one year.

Of 285 cases reported by Daniel,²⁰ 35 were operated on before two months from their first symptoms, 78 between two and three months, 77 between four and six months, 81 between seven and twelve months, 49 later than one year.

Leaving out of consideration the technical difficulties of resection at the cardia, the accessibility of this portion of the stomach to direct observations through the gastroscope should render it possible to obtain the same if not better results than at the pylorus. From our own experience we are convinced that it is not a difficult matter under local anæsthesia thus to remove bits of tissue for microscopical examination from growths even though situated some distance within the stomach. We base this belief upon the fact that we have confirmed the diagnosis of gastric carcinoma involving the cardiac orifice by the removal of bits of tissue through the gastrosopic tube, and upon the fact that in the normal individual we are able to examine the cardiac portion of the stomach for a distance of three or four inches. Though our observations cover as yet a limited number of cases, it is certain that the large number of inoperable growths of the stomach would not exist if the gastroscope could be introduced as a routine method of examination in all new gastric cases.

The preceding discussion is necessary not merely to show the importance of the surgical field at the cardia, but to define just what this field is, and to demonstrate that the cardiac portion of the stomach is as important if not more important, than the lower end of the œsophagus, and must be included

in any plan of operative attack directed against carcinoma of this locality.

The introduction of thoracic surgery under conditions of differential pressure has demonstrated the accessibility of both these regions. Notwithstanding, however, the good exposure which this method of operating affords, every intrathoracic œsophageal operation thus far undertaken has been fatal.

OPERABILITY OF CANCER OF THE STOMACH.

Author.	No. cases.	No. resections.	Mortality.	No. traced.	Died later.			Well when rep.	Cases well over 3 yrs.
					½-1 yr.	1-2 yrs.	2-3 yrs.		
Rydygier ³⁷ (1901).....	100	25	17	22		2	1		
Clairmont ³⁸ (1905) (Eis-elsberg).....	258	32	6	...	7	6	2	6	2
Mayo ³⁹ (1906).....	...	100	14	63	17	8	2	65	5
Creite ⁴⁰ (1907, Braun)...	211	50	19	...	24	16 mo. — 1 yr.)		6 (6 mo. 1-½ yrs.)	1
Makkas ²⁸ (1907) Mickulicz.....	458	167 (4 ex-tirp.)	1891-'98, 25 out of 55; 1899-1900, 9 out of 40; 1901-'04, 23 out of 68	82	21	26 (6 died of recurrence bet. 4-6 yrs. later)	6	27	3
Riese ⁴¹ (1908).....	89	24	7	...				5 (7 mos. - 5 yrs.)	1
Daniel ²⁹ (1908).....	395	73	21	71	40	10	20% operable		
Derjushinsky (1909) quoted from Rasumowsky.....	...	6	1						
Rasumowsky ⁴² (1909)...	...	5	2 (1 in 17 days from hemiplegia)						
Kocher ⁴³.....	...	92	14 (2 out of last 21)	...					18
Kindl ⁴⁴ (1909).....	112	16	7						
Poncet ⁴⁵ (1909).....	169	40	14	18	7	7		5 (½-5½)	2
Kocher ⁴⁶ (1909).....	...	144	4†	100					22
Mayo ⁴⁷ (1910).....	...	266*	34	88					18†

Leriche⁴⁸ has collected 93 cases from various authors free from recurrence 3 years after operation.

Paterson⁴⁹, 86 resections, of which 21 have lived for 3 years and 12 for 5 years.

* 117 previous to 3 years ago. † Out of last 44. ‡ 13 over 4 years; 8 over 5 years.

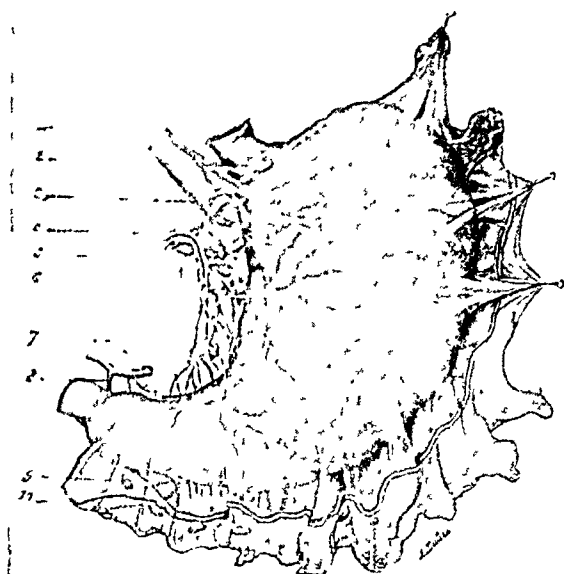
Only about 15 (10 by Sauerbruch) have been performed, and of these the most noteworthy are three attempted resections (Sauerbruch,⁵² Wendel,⁵³ and Tiegel⁵⁴).

Concerning operations upon animals, we are unacquainted with any successful series of typical resections of what would constitute a satisfactory length of œsophagus and stomach. Sauerbruch⁵⁵ has stated that in his hands an anastomosis by

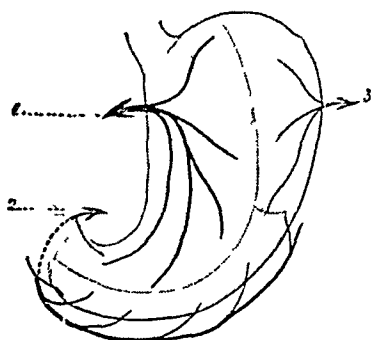
suture has failed, and his only successes have been obtained by either an anastomosis with the lateral wall of the œsophagus or by a two-staged operation in which at first the cardia is invaginated into the stomach and subsequently amputated through an abdominal gastrotomy. Tiegel's experience confirms that of Sauerbruch, but in order to save length of the œsophagus, and to avoid the formation of a blind pouch, he has devised a special button which permits of an anastomosis of the end of the œsophagus with the lateral wall of the stomach. He reports only one animal which lived after such an operation. Our first experience confirmed the views of both these workers. In the first series of resections in which the end of the œsophagus was anastomosed to the lateral wall of the stomach by suture, every animal died. We, therefore, also adopted the use of a button, a modification of the one described by one of us (N. W. G.), which had materially facilitated in his hands the operation of œsophagogastrostomy without resection. This button enabled us to make an aseptic union of the end of the œsophagus with the lateral wall of the stomach. The results, however, were not good, only 5 out of 60 dogs lived.*

These results and certain other considerations led us to attempt an entirely differently planned operation. We became convinced that the preservation of perfect asepsis was not the solution of the problem. Willy Meyer⁵⁴ and Carrel⁵⁵ had each accomplished one successful resection of a limited portion of the gut by an end-to-end union with suture. On the only two occasions upon which we have performed a plastic operation upon the wall of the thoracic œsophagus, we have obtained permanent healing in spite of considerable soiling of the pleural cavity with intra-œsophageal fluid. Further than this, no one of the procedures, thus far described as successfully worked out upon animals, permits of anything but the removal of a very limited segment of the œsophagus and

* It is important to note in connection with what follows that these dogs did not vomit and lived until they were killed, 3 to 8 months after their operations.



General view of the subperitoneal network of the stomach, injected by Gerota's method (Cunéo). 1, left pneumogastric, 2, præcardiac glands; 3, right pneumogastric, 4, coronary artery, 5, coronary vein; 6, gland of the small curvature, 7, hepatic artery, 8, right gastro-epiploic artery, 9, subpyloric gland; 10, right gastro-epiploic vein ending in the middle colic vein.



Lymphatic territories of the stomach (Cunéo). 1, the coronary or the principal current; 2, right gastro-epiploic current; 3, splenic current.

stomach. The worst of them all in this respect is the union of the lateral wall of the stomach with the lateral wall of the œsophagus (Sauerbruch and Wendel). A valuable length of the gut is thus sacrificed in a location where every millimetre counts. The same criticism to a lesser degree is true of an anastomosis of the end of the œsophagus with the lateral wall of the stomach (Tiegel ⁵⁴ and Green and Maury ⁵⁸). The sacrifice of distance by this procedure is also great and in addition results in the placing of a considerable weight upon the circle of union and much difficulty in the repair of the diaphragm.

In order to render an operation of resection of the cardia of practical utility, we believe that, first, an end-to-end union is necessary, and, second, that the stomach must be removed down to at least the prepyloric region. Only by adopting such a method can the parts be reunited without tension and the disease, against which this operation is designed, wholly eradicated. Aside from what has been previously mentioned regarding the situation of malignant disease of the lower portion of the œsophagus, a study of the lymphatic supply of the stomach will demonstrate why it is desirable to resect most of the lesser curvature. Cuneo ⁵⁹ has shown that the lymphatic vessels of the cardia and lesser curvature of the stomach converge toward the point at which the gastric branch of the celiac axis approaches the stomach returning over the course of distribution of the branches of this vessel. The accompanying cuts have been photographed from his work. Such a lymphatic distribution is perhaps one reason for cancer of the cardia so often invading the stomach for a considerable distance. It is, therefore, not simply for the purpose of broadening the scope of operation for cancer of the cardia that it is desirable to amputate so large a portion of the stomach, but rather to eradicate also, in one piece, the associated lymphatics.

We believe that an operation planned in the manner which we have indicated in addition to the advantages already outlined is also far more practical from a technical stand-point than any other hitherto described. We have mentioned the poor results which we have had in our first two series of dogs

in which we made limited resections. In our last series, however, operated upon by a method worked out by one of us (H. H. J.), herein described in detail, and to which reference is made in the preliminary report on page 58, an end-to-end anastomosis is made with suture and the stomach is resected as far as the prepyloric region, thus utilizing the pyloric portion of the stomach to bridge the gap left by the resected gut. Of this series 10 dogs have made perfect operative recoveries out of 17, and of the last six only one was lost. These dogs healed well and continued to live for four weeks to two months after the operation. During this time they seemed in perfect health except for more or less vomiting. As a rule they redevoured and eventually retained a good deal of their vomitus. Between four weeks and two months after operation all of the dogs died in an emaciated condition. With the exception of one dog which had an ulcer of the stomach and another which died of pneumonia, the autopsies revealed a perfectly normal mucosa from the beginning of the œsophagus to the end of the duodenum. Nothing pathological was found in the other organs, and we believe that the dogs must have died from inanition. Pachon and Caballo⁶⁰ have shown that a dog may gain in weight and remain in perfect health after the removal of the entire stomach. The greatest care as regards feeding was conspicuous in their experiment. If it had been possible for us with the help at our command to have given our dogs an equal amount of care, particularly concerning the frequent feeding of small quantities, they might have continued to live.

It has seemed to us that the subsequent death of our animals was due to an insufficient amount of food passing the pylorus, and this in turn dependent upon two factors, first, a loss of propulsive force on the part of the stomach and, second, the presence of a more or less unrelaxing pylorus. Contributing toward the first of these factors are both the absence of a sphincter at the cardia and the failure of the stomach walls to receive vagus stimulation, this nerve having been divided as a consequence of the operation. Contributing toward the

second of these factors is the loss of any inhibitory action of the vagus upon the pyloric sphincter.

In human beings, to whom it is possible to give better care in the matter of feeding, death may not follow in the same manner. Paterson⁴⁰ has collected 27 cases of total gastrectomy in the human being. Of these 17 have made perfect operative recoveries and lived in health for some time later. At the time of his report 12 were still well. Since then Moynihan⁶¹ has reported another case and Pauchet⁶² and Viannay⁶³ each two additional ones. There is abundant evidence, therefore, that the mere removal of the stomach is not a fatal operation. Should, however, the resection of the lower extremity of the œsophagus with the cardiac portion of the stomach as far as the pyloric region present in human beings the same difficulty which we have met with in the dog, two additional operations which we have performed both successfully and consecutively indicate the proper method of overcoming the trouble. In these operations the same œsophago-gastrectomy was performed, but with the additional step of the division of the pyloric sphincter down to, but not through, the mucous membrane; and repair of the incision, as in pyloroplasty, by sewing the wound up in the direction of its length. These dogs eat well and practically have not vomited since the operation. They present a marked contrast to all the other animals referred to, and thus far (three and four weeks after operation) have held their weight. In the end-to-end anastomoses which we have performed upon dogs, the larger opening upon the stomach side has not first been narrowed down after the first method of gastroduodenostomy by Billroth, but the redundant portion of the mucous membrane around the opening into what remains of the stomach is gathered in by a running stitch, which sews the œsophageal mucosa to the mucous membrane of the stomach, taking more stitches through the latter than through the former.

The series which we present is small and our work may be held to be still incomplete because of the fact that no dog has yet lived longer than $2\frac{1}{2}$ months. Nevertheless, we believe

that as far as it has yet gone it is worth reporting and demonstrates the technical possibilities of the operation which we are discussing. In the first place, a successful end-to-end suture in the type of operation which we have described has not yet been accomplished to our knowledge by any other observer. Secondly, it offers a very considerable number of advantages over the methods hitherto advocated for dealing with carcinoma of the cardia.

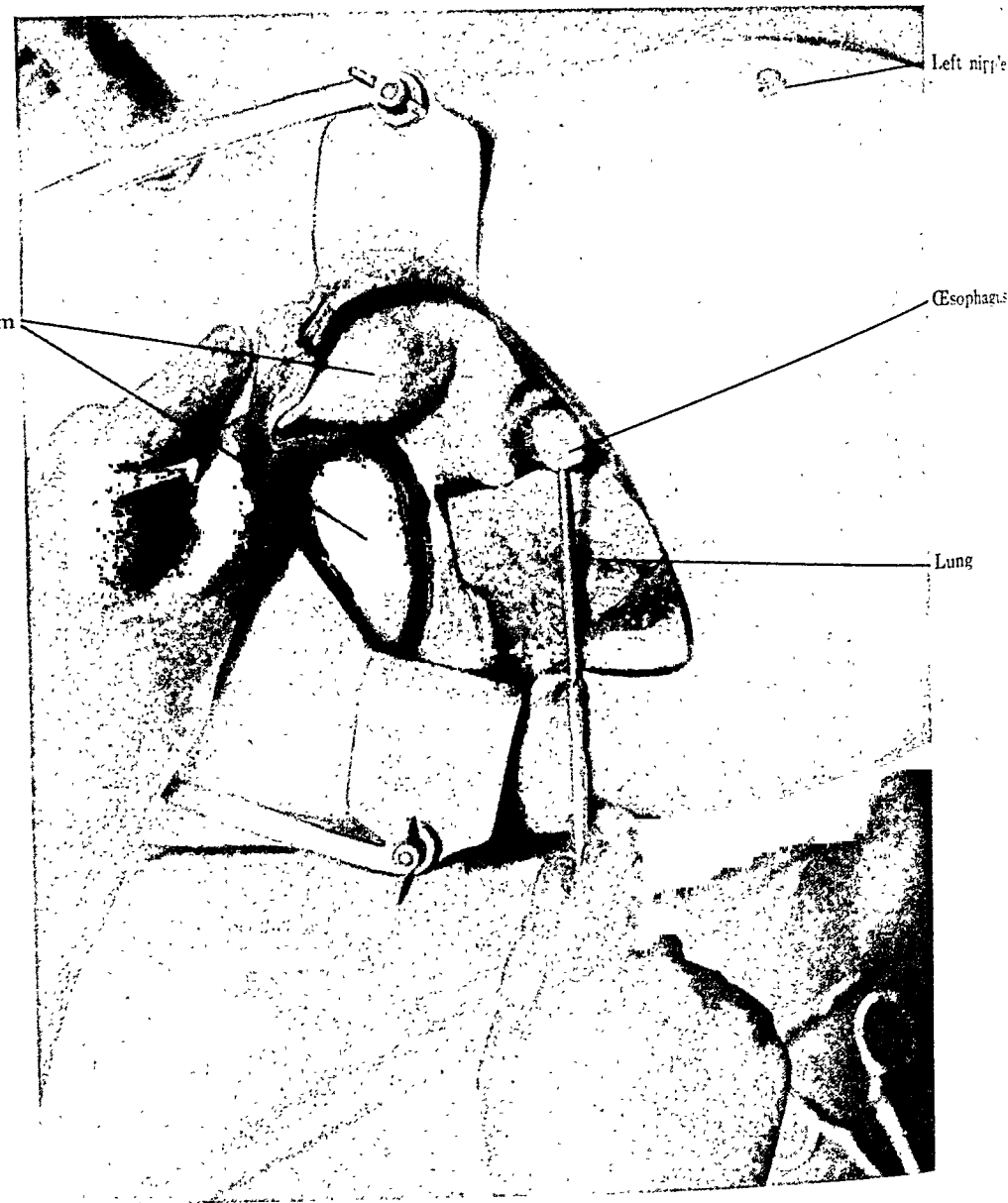
We have worked out the details of this operation upon the human cadaver and photographed the various steps. The reproduction of these photographs shows how real are the advantages claimed. In the dog the entire operation is performed through the thorax, but in the human being it is much more convenient to do the first stage within the abdomen. Figure 1 represents the stomach delivered through a median abdominal incision. The gastric, pyloric, and right and left epiploic arteries are tied and the lesser and greater omenta have been divided. The patient is now turned on the side and the eighth rib is resected. The costal cartilages of the next one or two ribs above are divided, and self-retaining retractors are inserted. Figure 2 illustrates the œsophagus hooked forward. The fold of the left crus of the diaphragm is in front of it, and the tip of the lower lobe of the left lung is at the side. The pneumogastric nerves may now be separated from the œsophagus. Should this prove impossible they may be divided. We have divided the pneumogastric nerves immediately before they pierced the diaphragm in five dogs (this being the only operative procedure on these animals). Two of these dogs died suddenly about five to six weeks after their operations. The autopsy revealed no cause for their death. The mucosa of the stomach showed, contrary to the opinion of Zironi⁶⁴ no sign of ulceration. The other three dogs are alive and healthy. An incision is now made between the left crus and the œsophagus into the peritoneal cavity. Through this opening the stomach may be pulled up. This procedure renders it very easy to tie off the gastrohepatic and gastrosplenic ligaments.

FIG. 1.



Stomach delivered through median abdominal incision.

FIG. 2.

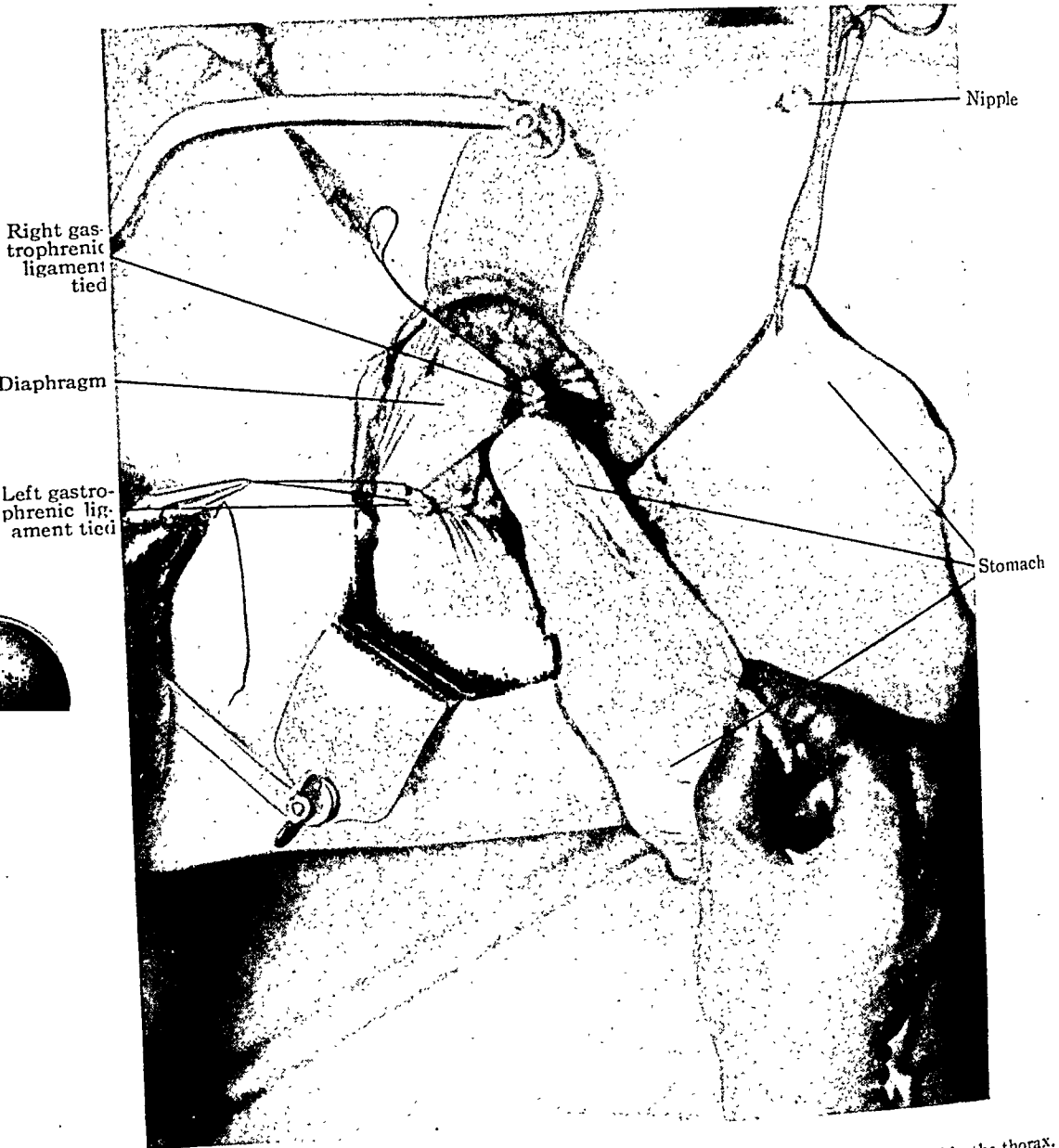


Chest open through floor of eighth rib. Esophagus hooked forward over aneurysm needle which crosses the left lower lobe of lung. Diaphragm held down by spatula.



Stomach pulled into the thoracic cavity. Pylorus emerging through the diaphragm to left, and esophagus disappearing behind lung to right. Ligature passes around the remnants of the left gastrophrenic ligament.

FIG. 4.



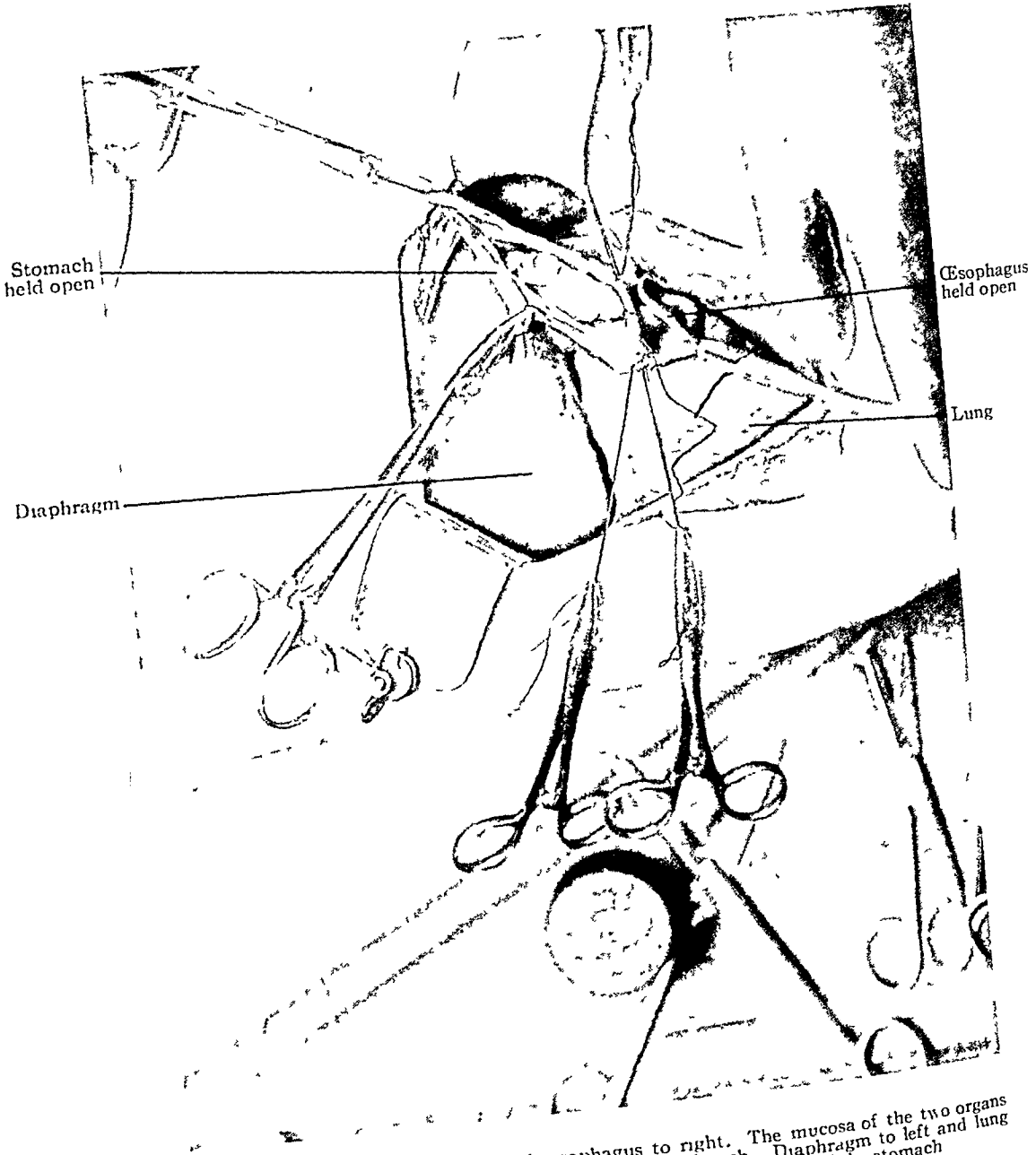
Gastrophrenic and gastrohepatic ligaments tied, and stomach and oesophagus entirely free within the thorax.

Fig. 5.



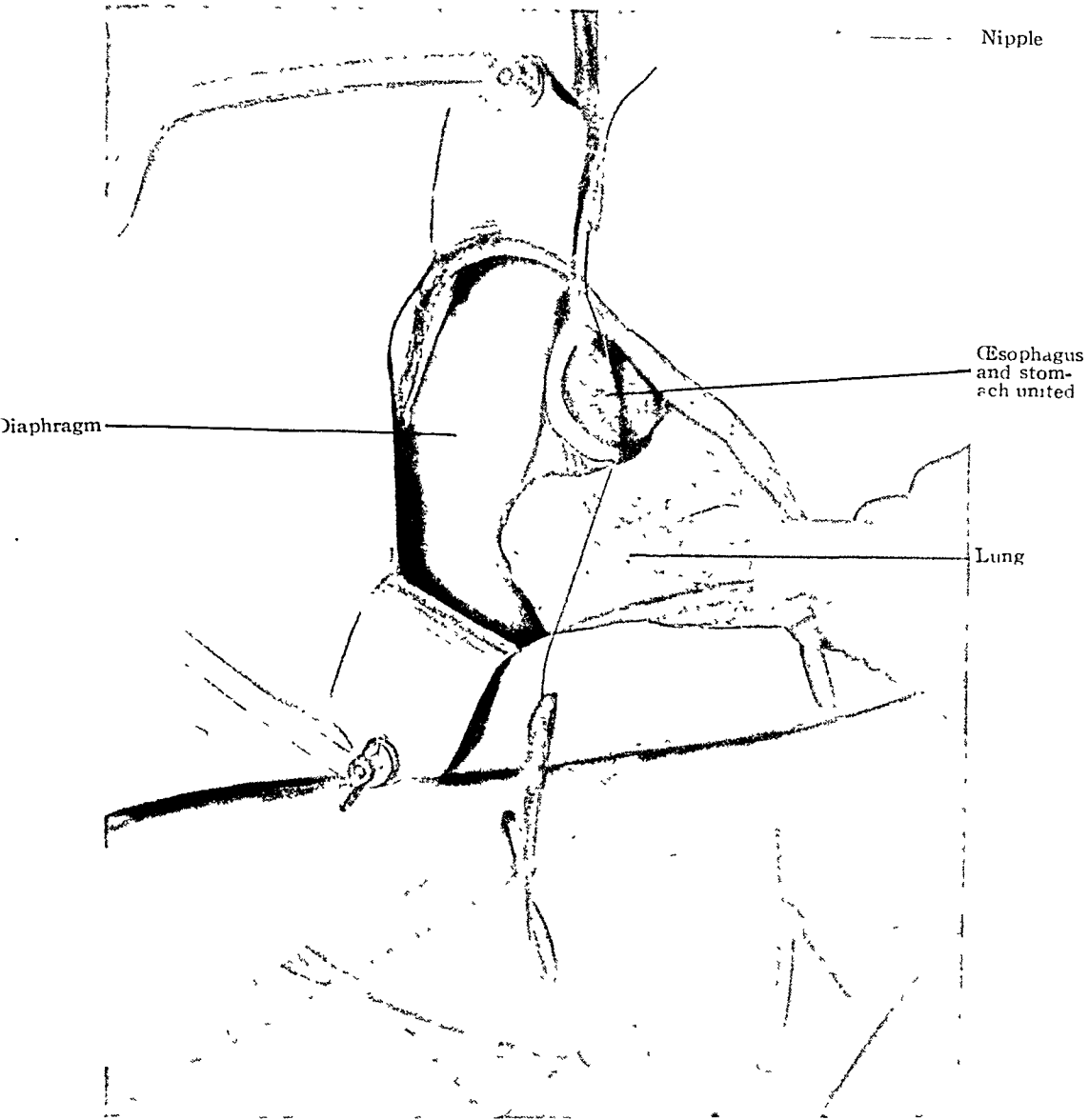
Portion of stomach and esophagus to be amputated between the clamps.

FIG. 6.



Divided stomach to left and esophagus to right. The mucosa of the two organs have been sewed together for half the distance around each. Diaphragm to left and lung below and to right. Sponge has been placed within the open lumen of the stomach

FIG. 7.



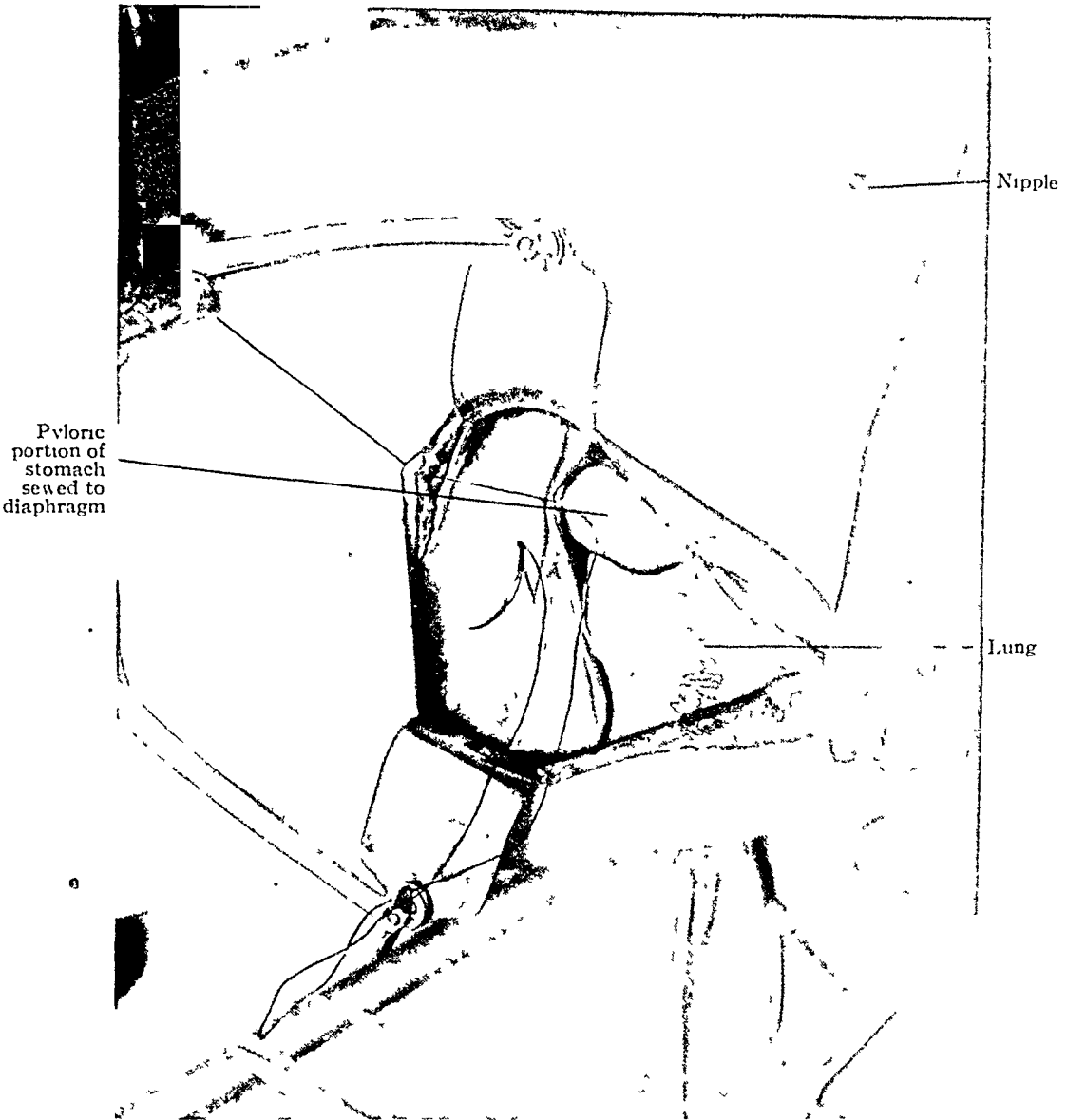
Shows the mucosa of the stomach completely sutured to that of the oesophagus, and the anterior serous covered walls of these viscera ready to be united by the external layer of sutures.

FIG. 8.



The stitching of the serosa of the stomach to the anterior pleural covered wall of the esophagus has been completed in front and this illustrates the posterior walls of these two organs pulled round to the front in order that the cystic flaps of "nature" may be completed all the way around.

FIG. 9.



Pyloric portion of the stomach being sutured to the opening through the diaphragm. The line of suture between stomach and œsophagus is covered by lung

Figure 3 shows the stomach delivered into the thorax and a ligature passed around the remainder of the left gastro-phrenic ligament. Figure 4 shows the right and left gastro-phrenic ligaments tied off, and the stomach and œsophagus entirely free within the thorax. Now the resection may be completed and it is easy to see from the photograph how readily the resected portion of the œsophagus may be replaced by the pyloric end of the stomach, permitting in this way an anastomosis without tension. Figure 5 shows the portion to be resected isolated by two clamps, and two retention sutures placed on each side above and below the clamps. A light spring clamp is now applied to the œsophagus above, and the whole area well padded off. The portion to be resected is now removed by the scissors. The two retention sutures previously tied hold the open ends of the gut together. By a running suture, which Figure 6 shows completed for one-half the circle of an anastomosis, and all the way around in Figure 7, mucous membrane is sewed to mucous membrane. The redundant portion of the stomach mucous membrane is gathered in by taking more stitches through it than are taken through the œsophagus. External to this layer a row of interrupted silk sutures uniting the peritoneal surface of the pylorus to the external wall of the œsophagus finishes the anastomosis. The anterior walls of these two organs are first sewed together and lastly, by simply pulling the gut around by the retention sutures, the posterior half is completed. Figure 8 shows the anastomosis completed, and Figure 9 the gut being sewed to the margin of the opening through the diaphragm.

CONCLUSIONS.

1. The aboral end of the œsophagus and the cardiac portion of the stomach must be considered as one surgical region.
2. Cancer in this location is by no means infrequently met with.
3. We believe that it permits of an early diagnosis by means of the gastroscope.

4. An operation of practical utility for resection of cardiac cancer must remove not only a portion of the œsophagus but also a considerable part of the stomach, in particular the lesser curvature.

5. Such an operation can be accomplished without undue tension by an end-to-end anastomosis with suture.

6. By an operation of this character it has been possible for us to obtain 10 operative recoveries out of 17 dogs and 5 out of the last 6.

7. As a preliminary report it may be stated that the death of the recovered animals about six weeks after the operation is due to an interference with the normal physiology of the pylorus, and may be prevented by the simple pyloroplasty herein described.

8. From a technical stand-point such an operation can easily be performed upon the human being.

POSTSCRIPT.—Since returning the manuscript of the above to the printers the authors have operated upon a patient with cancer of the cardiac portion of the stomach involving the œsophagus, by the method which they have herein described. The patient had had symptoms for the preceding nine months, and the operation required was an unusually severe one. The spleen was involved in the carcinomatous mass and was removed in one piece together with the stomach and lower portion of the œsophagus. The patient died fifty-four hours after operation, of empyema, starting, apparently, in a small perforation situated in the circle of anastomosis, a complication which we believe can be more carefully guarded against in the future. This experience, however, and the condition of the specimen removed demonstrate that the technic employed was satisfactory and that the operation is feasible and justifiable. In the future, instead of making two incisions in extensive cases, we should advise the use of one incision beginning a little posterior to the axillary line over the eighth rib, running over this rib to its cartilage, then curving downwards, and ending at the umbilicus. Through this incision the costal cartilages attaching the lower ribs to the sternum may be

divided, and a good approach obtained to the upper abdomen and the thorax. The chest should not be opened until the completion of the intra-abdominal work. We desire to thank Dr. Geo. Brewer for material assistance rendered at this operation.

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ON THE EXPERIMENTAL SURGERY OF THE THORACIC AORTA AND THE HEART.*

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INTRODUCTION.

DURING the last winter, I performed some experiments with the view of improving the general technic of intrathoracic operations and of finding special methods which could be used for the treatment of certain diseases of the heart and of the aorta. It is probable that the aneurisms of the thoracic aorta could be extirpated and the circulation re-established by a vascular transplantation, if a proper technic was developed. It seems possible, also, that some valvular and vascular diseases of the heart might be improved by surgical therapeutics. Nevertheless, the surgery of the heart has been limited entirely to the treatment of the wounds. A few experimental studies of this subject, however, have been made in the laboratories of Frederick in Marburg and of Harvey Cushing in Baltimore. But, in spite of their comparative simplicity, these experiments have been followed by a heavy mortality. Their results and the high death rate given by the operations on human beings show that the general technic of intrathoracic surgery is still insufficiently developed. Therefore, before describing the special methods that I found, it is necessary to study the procedures which permit the use of them without great danger.

GENERAL TECHNIC.

The bad results following the intrathoracic operations in experimental as well as in clinical surgery are due to a lack of adaptation of the technic to the physiological conditions of

* Read before the American Surgical Association, May 5, 1910.

the chest. The complications which often kill the animal or the patient are brought about directly or indirectly by the infection of the pleural or pericardiac cavities, or by the respiratory disorders caused by the penetration of the air into the thorax.

Pleural infection is the more dangerous of these complications. In one hundred fatal cases of wounds of the heart treated by suture, death was the result of sepsis sixty times. The constant failure of the extirpation of œsophageal cancer is due generally to the same cause. The experimental results are also very far from being satisfactory. Many animals operated by Sauerbruch and Haecker in Germany, or by Bernheim, Robinson, Janeway, and Green in this country died of purulent or serofibrinous pleuresis, or of pneumothorax caused by the secondary opening of a bronchus or of the thoracic wall. Nevertheless, the operations were generally not very complicated and extensive. The high death rate is due to the lack of understanding by many surgeons that pleura and pericardium do not react against infection as peritoneum does. The technic which permits a successful abdominal operation may be insufficient when used in intrathoracic surgery. The degree of infection which does not interfere with the healing *per primam intentionem* of a wound can probably cause the failure of certain vascular or thoracic operations. It is well known that between absolute asepsis and the degree of infection which produces the ordinary symptoms of inflammation there is a number of intermediate stages. The so-called aseptic wounds are almost always slightly infected. Often surgical asepsis is merely a condition of non-suppurative infection. But the attention of the surgeons has not been attracted by the various forms of attenuated infection, because it does not prevent the healing of ordinary wounds. Nevertheless it seems probable that the more marked states of non-suppurative infection can be very dangerous in intrathoracic surgery. It is, therefore, necessary to use in vascular and intrapleural operations better asepsis than it exists in many hospitals and laboratories.

This higher degree of asepsis can be obtained by the rigid application of principles known by every surgeon, but often neglected partially in the management of the operating rooms, the preparation of the patient, of the operators, the handling of the tissues, etc. The success of the more complex intra-thoracic operations depends on the observance of a number of minute details of technic. It is necessary mainly to remove some of the principal factors of irritation and inflammation of the pleuræ during the operation. The handling with forceps or retractors, the sponging, or the walling off with gauze, the exposition of large surfaces to the air bring about irritation of the pleura and facilitate greatly its infection. As soon as the thoracic cavity is opened, the lungs must be covered with fine Japanese silk compresses, impregnated with vaseline. The silk tissue acts as a thin and almost impermeable membrane which protects the pleura, without irritating it, against the contact of the fingers, and permits a very efficient walling off of the operating field. At the same time, it prevents the evaporation and the desiccation of the surface. In order to prevent the cooling of the viscera, a piece of thick flannel is placed on the silk compresses. Besides, the temperature of the operating is very high, 29 or 30° C. It is important not to allow the blood to flow through the pleural cavity. The sponging of the pleural cul-de-sac may be a cause of infection. All handling of the unprotected pleura or pericardium is dangerous.

The usefulness of a rigid asepsis is shown by the results which were obtained. I made twelve operations similar to those performed by previous experimenters, resection of pulmonary lobes, resection of a small segment of the middle part of the œsophagus, simultaneous opening of both pleuræ and pericardium, dissection of mediastinum and ascending aorta. It must be remembered that the suture of the œsophagus gave such constant mortality that Janeway and Green thought success was not possible and devised a very ingenious and complicated method for œsophageal anastomoses. Again, Sauerbruch, Robinson and others found that secondary pneu-

mothorax may follow lung resections, and Willy Meyer developed a very elaborate method for closing the bronchial stump. Nevertheless, I did not use those technics. I employed only the simplest sutures or ligatures, and the animals, without exception, recovered. Although this technic has given better results than those obtained by previous experimenters, it is still far from being ideal. After more complicated operations like patching of the vena cava, graft of vessels on the heart, simultaneous operations on the heart and the descending aorta, when very large exposure of the thoracic cavity is rendered necessary, I observed some serofibrinous or purulent pleureses. On twenty-eight operations of that class, seven times this complication occurred. Several animals died of secondary hemorrhage from aortic patches or cardiac sutures, and it is possible that the infection played also a rôle in these complications. Nevertheless there is no doubt that even in very complex operations, septic complications can be avoided. It is of great importance for the future of intrathoracic surgery that this part of the technic is completely developed.

The asphyxia which follows the opening of the thoracic cavity may be due to the pneumothorax, to a spontaneous stopping of the respiration, or to the inefficiency of the respiratory movements produced by a large opening or a strong retraction of the thorax.

The asphyxia produced by pneumothorax is easily prevented by the use of a Sauerbruch or Brauer chamber. Recently Willy Meyer and his brother Julius Meyer have built a splendid apparatus, which combines the advantages of both methods. On man, unilateral pneumothorax is not very dangerous and extensive intrathoracic operations have been performed without any apparatus. But it is very much safer to use a positive or negative pressure apparatus, which prevents completely the respiratory troubles caused by the pneumothorax.

When asphyxia is produced by the spontaneous stopping of the respiration, the Sauerbruch method becomes inefficient,

and does not prevent the patient or the animal from dying. In the more extensive operations, when the chest is widely opened, and the thorax dislocated by a strong retraction, the ribs and the diaphragm cannot act any longer on the lungs, and asphyxia occurs. In these cases also the Sauerbruch method cannot prevent the death of the animal. On the contrary the life of the animal will go on normally, if the Meltzer and Auer method of intratracheal insufflation is used. Their method has the very important advantage over all the others of permitting the respiratory exchanges to continue even if the respiratory movements have stopped or become inefficient. The apparatus I used is composed of only a foot-bellows, a rubber tubing connected with an ether bottle, and a manometer, and a small intratracheal catheter. With the method of Meltzer and Auer, the spontaneous respiration becomes a luxury because even when the respiratory movements cease or become inefficient, the ventilation of the lungs still goes on and the animal remains in excellent condition. By its simplicity and its efficiency, the method of Meltzer and Auer is a great advance in experimental surgery. It is actually the safest method for performing extensive operations on the chest.

Among the factors which bring about the success or the failure of an intrathoracic operation, the more important is not the apparatus which prevents the respiratory disorders caused by the pneumothorax. The main danger is not asphyxia, but infection, as it has been demonstrated by the results of many experimental and clinical operations in this country and in Europe. The technic must be improved, therefore, by better asepsis rather than by complicated apparatuses.

SPECIAL TECHNIC.

I attempted to find new methods which could be used for the treatment of the aneurisms of the thoracic aorta, and of the valvular and vascular diseases of the heart.

The diagnosis of the aneurisms of the aorta can be made to-day at a comparatively early period. It is rational to think that some of them can be extirpated. Therefore we must find

methods which permit repair to the aortic wall after a partial or complete resection.

We know that the lumen of an artery can be reduced without interruption of the circulation by the operation I described a few years ago as longitudinal exclusion. This method could be used for a sacciform aneurism, with narrow pedicle. But, in most cases, a resection of a part of the wall or of a complete segment would be necessary. I have already demonstrated that after a partial resection, an arterial wall can be patched with a piece of artery, of vein, or even with a piece of peritoneum. These operations present very little danger, and their results, observed many months after the graft, were excellent. I succeeded also in substituting to a part of the abdominal aorta a piece of rubber sheeting. The circulation went on normally and is still normal after several months. In a number of other operations, I found that entire segments of veins and of arteries, fresh or preserved in cold storage, can be transplanted on arteries. The results observed after several years are excellent, and the operation performed under certain conditions is very safe.

The patching and grafting of entire vascular segments would permit the re-establishment of a normal circulation after resection of a sacciform or fusiform aneurism. But, the technic must be adapted to the special anatomical and physiological conditions of the intrathoracic aorta. Its wall is exceedingly friable, especially in the ascending part of the arch. It is very easily cut by the threads. It has, therefore, been necessary to modify in a large measure the ordinary technic of vascular suture. The sutures and anastomoses on the thoracic aorta are less difficult but more dangerous than on the other arteries. Every detail of the technic must be directed toward the prevention of secondary hemorrhage. This complication is liable to occur after aortic suture, while it does never happen after suture of the abdominal aorta and other arteries. Parietal thrombosis, which is generally a very dangerous complication, does not produce any trouble when it develops on the aortic wall. On account of a possible

hemorrhage it is more dangerous to graft a piece of vessel on the thoracic aorta than on another artery.

It was necessary also to find out a method for diverting the blood during the operation, because the aortic circulation cannot be interrupted for a long time without the occurrence of nervous complications. The main danger of the aortic operation does not come from the heart or from the aorta itself, but from the central nervous system. When the descending aorta is clamped for more than ten or fifteen minutes, the posterior limbs become paralyzed. It is generally a spastic paralysis. The lesions are localized to the cells of the anterior horn. It seems that the clamping of the ascending aorta cannot be continued without danger for more than one minute. A smaller operation like the suture of a wound can be performed in less than one minute. We can also make a circular suture of the descending aorta in six and even in three minutes. But the resection of an aneurism, and the graft of a vessel would take a very much longer time. Therefore, I tried to develop a technic for the temporary diversion of the blood.

The diversion of the blood can be produced in two different ways—by temporary intubation of the aorta or by an artificial collateral circulation, *i.e.*, a *central* or *lateral* diversion of the blood.

The *central* diversion consists of tubing the segment of the aorta which is to be resected. The vessel is laid open by a longitudinal incision and a paraffined tube is inserted into its lumen and temporarily fastened. This small operation involves only a short interruption of the circulation. Then the wall of the aorta can be extirpated and replaced while the circulation goes on through the tube. When the operation is completed, the tube is removed through a small incision in the wall of the aorta. There is no danger of coagulation of the blood in the tube during the operation. The patching or the transplantation of an aortic segment can always be performed in less than an hour, while the circulation can go on for several days through the tube before coagulation occurs.

It is a safe and convenient method for the descending aorta. It can be probably used also on the ascending aorta.

The *lateral* diversion consists in establishing a communication between the left ventricle and the descending aorta, or between two parts of the aorta. I have used only the first method. The anastomosis between the left ventricle and the descending aorta is made by means of a paraffined rubber tube or of a large jugular vein preserved in cold storage. One end of the vessel or of the tube is inserted into the apex of the left ventricle and fastened. The other end is inserted into the descending aorta. The ascending aorta is clamped. Then the blood goes directly from the left ventricle to the descending aorta. The direction of the blood stream is reversed through the upper part of the descending aorta, which acts temporarily as an ascending aorta. There is, therefore, no danger of anæmia of the brain. But the operation is still very dangerous because the details of the method are not sufficiently worked out. The mortality was heavy. Before being safe the technic must be considerably improved. Nevertheless, I succeeded several times in anastomosing the left ventricle to the descending aorta and in reversing the circulation through the upper part of the descending aorta, after clamping the arch of the aorta just above the heart. In one experiment the anastomosing tube was very much narrower than the arch of the aorta. As soon as the ascending aorta was clamped, the heart began to beat slowly, and the blood passed with a strong thrill from the ventricle to the descending aorta. In the brachiocephalic arteries pulsations and a marked thrill were felt. The coronary vessels were dilated. The circulation was thus maintained for eight minutes. The animal remained in excellent condition, and when the clamp and the tube were removed, the circulation was re-established in its normal direction. Nevertheless the lateral diversion is still very much more difficult and dangerous than the aortic intubation.

Although my technic was being developed during the course of the experiments and is still far from being perfected,

some new and permanent results were observed. In one experiment the ascending aorta of a dog was incised and sutured by Jaboulay stitches. Two months and a half after the operation, the vessel was examined. The wound had healed perfectly and the scar was very small. In six experiments the transverse suture of the descending aorta was performed, after complete or incomplete section. One dog died of secondary hemorrhage a few weeks after the operation. The others recovered completely. One of them was chloroformed two months and a half after the operation. The anastomosis was found normal without dilatation or stenosis. The remaining dogs are in normal health more than five months after the operation. The patching of the aorta with a piece of vein was made twice. The animals died eight days and twelve days after the operation of secondary hemorrhage. The accident was due to necrosis of the flap in the one case and in the other to the tearing of the flap by a stitch. These complications can be prevented by slight modifications of the ordinary technic. I performed once only the graft of a complete venous segment between the cut ends of the descending aorta. The operation was performed five months ago. The animal is still in excellent health and there is no modification of the femoral pulse. It is, therefore, probable that with the help of the methods for temporarily diverting the blood, certain aneurisms of the aorta on man can be removed and replaced by a piece of vein.

I attempted also to find out some method for the treatment of valvular diseases and localized sclerosis of the coronarian arteries. Theoretically, many operations can be performed on the heart,—incision and dilatation of stenosed valves, cuneiform resection and stenosis of the upper part of the ventricle in case of mitral insufficiency, curettage of endocardiac vegetations, grafting of new vessels on the auricle and ventricle, collateral circulation between two cavities of the heart, aorto-coronarian anastomosis, etc. The development of these technics is not far advanced for I have studied the conditions under which the operations must be performed rather

than the operations themselves. Plastic operations on the heart are not very much more difficult than on any other parts of the body. But to perform the operations without disturbing in an irreparable manner the functions of the nervous system and of the heart itself is a very complicated problem.

The cardiac operations can be artificially divided into three classes: operations which do not require the hæmostasis of the heart, operations which require the hæmostasis for a very short time, and operations which require the hæmostasis for a longer time and the stopping of the heart.

1. Several operations can be performed without the help of the temporary hæmostasis, such as digital exploration of the ventricles or the auricles, dilatation of the mitral valve, dissection and preparation of a coronarian vessel for anastomosis, incomplete ventriculectomy and suture, etc. I tried to develop an operation for mitral insufficiency which could be performed without opening the heart. It consists of producing a slight stenosis of the upper part of the left ventricle. It can be obtained by a partial cuneiform resection of the wall of the ventricle just below the coronary artery. A dog which has undergone this partial ventriculectomy two months ago is still in good health.

2. In the operations of the second class, the cavities of the heart are open for about one minute, during which time it becomes possible to insert and fix a tube or vessel into the ventricular or auricular cavities, to open largely and to suture the ventricular wall. It would be feasible also to cut a mitral or tricuspidian valve, or to perform the curettage of endocardiac vegetations. I tried to determine what are the best conditions under which that type of operation must be performed. The hæmostasis can be secured by the clamping of the venæ cavæ as advocated by Sauerbruch. But it is simpler to clamp with a large soft-jawed forceps the entire pedicle of the heart. As the interruption of the circulation does not last more than one or two minutes, it causes no cerebral complications. The main danger is the occurrence of fibrillary contractions, which render almost impossible the

re-establishment of normal pulsations. I performed clamping of the heart eight times, with or without cardiectomy, for from one to five minutes. One dog died of respiratory complication, another one of fibrillary contractions, because the needle went through the dangerous region of Cyon, and the others recovered. In case of mitral stenosis, it would be easy to make an incision of the valve. It would be probably possible also to establish an indirect auriculoventricular anastomosis by a vein implanted on the left auricle and ventricle. I succeeded in fastening temporarily a tube into the left auricle and ventricle. The blood was circulating through it with a strong thrill. At the end of the operation, the tube was removed. The animal remained in good health.

3. To the third class belong the operations requiring the interruption of the circulation for a longer time. They would consist of more complicated plastic operations on the cardiac wall, and of the operations on the coronarian arteries. In certain cases of angina pectoris, when the mouth of the coronary arteries is calcified, it would be useful to establish a complementary circulation for the lower part of the arteries. I attempted to perform an indirect anastomosis between the descending aorta and the left coronary artery. It was, for many reasons, a difficult operation. On account of the continuous motion of the heart, it was not easy to dissect and to suture the artery. In one case I implanted one end of a long carotid artery, preserved in cold storage, on the descending aorta. The other end was passed through the pericardium and anastomosed to the peripheral end of the coronary, near the pulmonary artery. Unfortunately, the operation was too slow. Three minutes after the interruption of the circulation, fibrillary contractions appeared, but the anastomosis took five minutes. By massage of the heart, the dog was kept alive. But he died less than two hours afterwards. It shows that the anastomosis must be done in less than three minutes. Perhaps this can be done by using a lateral implantation with a Payr's canula.

The safest method of performing a comparatively long

operation would be to suddenly place the heart in a condition of anæmia. It is well known that the heart loses its excitability very slowly, and that, by using a proper method, it can be revived after a long period of immobility. We do not know exactly for how long it is safe to keep the heart motionless. But the complete stopping of the circulation is more dangerous for the organism than for the heart. The artificial stopping of the circulation and the opening of the cardiac cavity would place the patient in the condition of a man killed by a bullet through the heart immediately after the last respiration and the last cardiac pulsation. This condition is called general death. But it is merely unmanifested life or latent life. The organs, being deprived of circulating blood, are not able to manifest life any longer. But they are still living and could revive, if they were given back their normal physico-chemical conditions. Latent life is a very instable state. Without the circulating blood, the tissues are not able to protect themselves against the microbes and the autolytic ferments, which bring about progressively protoplasmic disintegration, that is, *elemental death*. *Immediately after the artificial stopping of the heart, the organism is placed in a condition intermediary between general and elemental death.* This condition is, from a medicolegal standpoint, death. Nevertheless, as long as elemental death has not taken place, the organism can be resurrected. Therefore, the length of the period during which we can stop the heart safely depends on the rate of the development of elemental death. The brain disintegrates first. It is well known that complete ischæmia of the encephalon produces irreparable lesions. Nevertheless, a short interruption of the circulation is not very dangerous. On a dog, the chest was widely opened, and respiration stopped while the pedicle of the heart was clamped for five minutes. Then the clamp was removed and pulmonary ventilation started again by the Meltzer and Auer method. The animal was easily revived. He recovered completely and never presented any psychological troubles. It is known that, when the interruption of the circulation lasts longer, very marked

cerebral lesions occur. I found also, that in an animal, revived after a long period of cerebral ischæmia, the upper nervous centres had disintegrated. The functions of the heart and of the lungs were almost normal. But the animal was paralyzed and appeared to have lost his intelligence and sensitiveness.

The time during which an animal can be maintained without great danger in a condition of latent life is very short. The technic must, therefore, be developed in such a manner that no cardiac operation should last more than five minutes. It seems possible, although dangerous, to stop the circulation and the respiration during that period and afterwards to replace the animal in a condition of normal life.

CONCLUSIONS.

1. The general technic of intrathoracic operations has been improved by the use of a better asepsis and of the Meltzer and Auer method of pulmonary ventilation.

2. Two methods for the diversion of the blood during the operation on the thoracic aorta have been found,—intubation and lateral diversion.

3. For the first time, it has been possible to perform with permanent success a suture of the ascending aorta, several end-to-end anastomoses of the descending aorta, and the grafting on the descending aorta of a segment of vein preserved in cold storage.

4. It has been attempted also to find and to study new cardiac operations, and the conditions under which they must be performed.

The technic of these operations is far from being completely developed. They must not be used on human beings under their present form. Their purpose was only to study some of the principles on which must be based the future surgery of the thoracic aorta and of the heart.

TREATMENT OF WOUNDS OF THE HEART.*

WITH REPORT OF TWO CASES.

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WOUNDS of the heart have for many ages been considered fatal, and it was not until within recent years that the surgery of this organ has been attempted. While cardiac injuries are comparatively infrequent, they are, however, of such seriousness that prompt surgical interference is demanded. It is for this reason that surgeons should be acquainted with a definite plan of procedure in the treatment of these emergencies.

The first surgical operation on the human heart was performed by Farina, of Rome, in 1896, and since this time the heart has come to be regarded as an organ amenable to surgical procedure just as the other organs of the body. At the St. Louis City Hospital there have been five cases of cardiorrhaphy. Two of these cases, in 1901, were operated on by Dr. H. L. Nietert, who was among the first in America to suture the heart. At the same institution Dr. Louis Rassieur, in 1903, had a case of heart-suture with recovery, so that during my term of service opportunity was afforded of seeing and treating four cases. Of the five cases operated on, three made successful recoveries.

During the past two years I have operated on two cases of stab wound of the heart. The first case when received was in a critical condition and lived only four hours after the operation. The second case was admitted to the hospital under more favorable conditions and his recovery was uneventful. The case histories are as follows:

CASE I.—The patient, W. S., a white male, thirty-seven years of age, a roofer by occupation, entered the City Hospital, Feb-

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ruary 11, 1908, at 6.15 P.M., with the history of having been stabbed with a knife while fighting.

Immediate Condition.—When received in the emergency room it was evident that the patient was in a state of great shock. He was conscious, but drowsy and restless, and his face bore an anxious expression. He seemed to be suffering and frequently cried out with pain. The skin and mucous membranes were pale, and the body was cold and he was in profuse perspiration. He complained of great thirst. The pupils were widely dilated and reacted slowly. No abnormal nervous reflexes were noticed. While being undressed the bowel moved voluntarily. The urine upon catheterization was found to be clear, but contained a trace of albumin and hyaline casts. The patient bled from the nose and from wounds in the chest and buttock. He expectorated a bloody mucus. The pulse was irregular, soft and small, and the rate 86 per minute; respirations, 28 and regular; rectal temperature 99.8° F.

Examination of Wounds.—The patient had a contused and lacerated wound of the nose which was the probable cause of the epistaxis. On the left side of the chest, in the fifth interspace and one inch external to the mammary line, there was a penetrating wound of the chest, which wound when explored with the finger was found to take a direction toward the heart and apparently to involve this organ. In the sixth costal interspace and one and one-half inches external to the wound just described there was a second penetrating stab wound of the chest. These wounds were about half an inch in length and the tissue surrounding them was emphysematous. Blood escaped in large quantities from the pleural cavity through these wounds, and over the lower and posterior portion of the chest on the left side, the percussion note was flat. There was a third stab wound in the left gluteal region.

Diagnosis and Prognosis.—With the pronounced symptoms of shock and hemorrhage and the location and direction of the wound in the chest, the diagnosis of stab wound of the heart was simple. It was also evident that the pleural cavity had been involved and that a traumatic emphysema was developing rapidly. The great degree of shock and hemorrhage, combined with the nature of the wounds, made the prognosis extremely grave. The only hope for life lay in the immediate control of hemorrhage.

Operation.—As soon as the nature of the injury was ascertained, the patient was prepared for operation. He was wrapped in hot blankets and heat was applied to the extremities. Ether anæsthesia was preceded by a quarter of a grain of morphine. When the patient was well under the anæsthetic, the operation was started and the administration of ether discontinued.

An incision through the skin at the outer border of the cardiac area and internal to the left mammary line was made, extending across the fourth and fifth ribs. From either extremity of this incision two other skin incisions were made, directed toward the sternum. With costotome, the fourth and fifth ribs were severed and the intercostal tissues were readily divided with scissors. An osteoplastic flap was thus formed and by forcible traction the flap was reflected to the right, a hinge being formed near the sternal margin. This gave access to the cardiac region, but, inasmuch as the hemorrhage was profuse and ample room for quick work was needed, the sixth rib was also severed and retracted. The pleural cavity was almost completely filled with liquid blood and blood clots, and the heart was beating but moderately fast. There were two incised wounds in the pericardium, from which blood flowed very freely. The infiltration of blood into the pericardial and fatty tissue altered considerably the normal appearance of the cardiac area. The pericardial sac when opened contained mostly liquid blood. The heart was lifted from the sac, and near the apex of the left ventricle there was an incised wound, three-fourths of an inch long, which bled freely. When the heart was raised the left ventricle emptied itself through this opening and the heart stopped beating. As quickly as possible a silk suture was placed to close the opening. By compression and massage of the heart pulsations of the organ were re-established, but the heart beats now became considerably accelerated and were perhaps from one hundred and forty to one hundred and sixty per minute. This made suture of the wound very difficult. Interrupted silk sutures were used, care being taken not to include the endocardium. The heart was supported in the left hand. Mattress retention sutures were placed to relieve the direct tension on the suture line, and the spurting from the partially sutured wound was so forcible that it was necessary to use eight sutures to effectually close the wound. The heart was inspected and no other source of hemorrhage found. The pericardium having

been cleansed, the heart was replaced and the pericardial incision closed with catgut. The ends of two of the heart sutures were left long and were brought through the pericardium and tied. A small gauze drain was placed in the pericardium and dependent drainage of the pleural cavity was established by means of a rubber tube. The wound in the chest wall was closed with catgut for the subcutaneous structures and silkworm gut for the skin.

While the operation was in progress the patient had received hypodermoclysis of saline solution, and this seemed not only to increase the volume of the pulse, but also to improve the heart's action. It was noticed that the lungs were not completely collapsed and that they would expand and contract with the respiratory movements. While suture of the heart was in progress, the patient, who had practically received no anæsthetic during the operation, stated that he was thirsty, that he wanted a glass of water, and then asked for a can of beer. Before closure of the pericardium, the patient made efforts at coughing and the lung and heart were forcibly pushed into the wound in the chest. The operation was performed in sixty-five minutes. When the patient was put to bed his pulse was 118, of fair volume, and the respiration was 30 per minute.

He became very restless and morph. sulph. gr. 1/6 was given. An hour after the operation, the pulse was 96 and respiration 24; two hours later the pulse was imperceptible, respirations 28, shallow and short, and rectal temperature 100° F. The respirations became labored, and the patient died four hours after the operation, apparently from shock and hemorrhage.

At autopsy there was no blood in the pleural cavity or the pericardium. When the heart was carefully examined, a second and much smaller stab wound of the heart was found which had been overlooked at the time of operation. This wound opened into the left ventricle and was through the fatty tissues near the septum. The wound could not readily be detected, and it was all the more remarkable that, inasmuch as the cavity of the ventricle had been penetrated, there was no bleeding from this wound, indicating that muscular contraction was sufficient to prevent leakage. The cause of death was attributed to shock.

CASE II.—The patient, M. L., a white male, twenty-four years of age, engaged as a mechanic's helper, was admitted to the City Hospital August 22, 1909, at 12.40 A.M., with the history

of having been stabbed in the chest with a knife about a half-hour before entering the institution.

He was well developed and well nourished, weighing 164 pounds, and of medium height. The patient had suffered with pneumonia and occasionally had attacks of bronchitis, but he had mostly been in good health.

When examined in the emergency room he was slightly under the influence of intoxicants. He was conscious, restless, noisy and somewhat unruly. The skin was pale, the body was cold and in cold perspiration. The pulse was very feeble and irregular and the rate 96 per minute. At times the beats were strong and then again almost imperceptible. Judging from the character of the pulse, it was evident that the heart was laboring under difficulty.

Examination of the chest showed a stab wound parallel with the fifth intercostal space and two and one-fourth inches below the nipple, the outer extremity being in the mammary line, and the wound extending inward for three-fourths of an inch. The wound was clean-cut and no other injury was noticed. There was profuse hemorrhage from the wound and his clothing was saturated with blood. The chest was carefully cleansed, and the wound was examined with the finger. The wound took a direction inward and downward, and the finger, entering the pericardium, detected a wound in the heart. When the finger was removed from the wound, there was a gush of blood which showed that active communication existed between the pericardium and the external surface. There was but little escape of air from the wound and a pneumothorax did not seem to exist. The respirations, 24 per minute, were shallow but regular. After the escape of blood from the pericardium the character of the pulse improved markedly. The diagnosis of stab wound of the heart was made and arrangements were made for immediate operation.

Operation.—General ether anæsthesia preceded by morphine and atropine was administered. When the patient was thoroughly anæsthetized, an incision was made between the fifth and sixth ribs extending from the stab wound to the left sternal border. A second incision was made upward from the outer end of this wound, sufficiently long to include the fifth and fourth ribs. The finger as a guide was introduced into the stab wound, and the tissues in the fifth intercostal space divided toward the sternum. The pericardial and pleural attachments were separated with the

finger from the ribs, and with the costotome the fifth and fourth ribs were easily divided. The third incision was directed inward along the third interspace, thus making a quadrangular, osteoplastic flap with the hinge at the left sternal margin. There was no bleeding from the intercostal vessels and the internal mammary artery was not injured. The opening was sufficiently large for cardiac manipulation and the pleura was but slightly injured.

The incision in the pericardium was about two inches long and was enlarged upward and downward. The pericardial sac was freed from blood and blood clots, and the heart lifted forward for inspection. A wound one and three-fourths inch in length was found extending obliquely across the left ventricle, the lower end being about one inch from the apex. Blood escaped very freely from the left ventricle, but the bleeding was controlled by placing the finger in the wound. Small tenaculum forceps were inserted at the lower end of the wound and the heart was thus gently suspended. Its own weight produced sufficient traction to cause the edges of the wound to coapt and to control hemorrhage sufficiently for the placing of the sutures. Three, deep, interrupted sutures extending to the endocardium were placed and hemorrhage now only took place in spurts. Seven intermediate sutures were necessary to completely control the hemorrhage. The line of sutures was reinforced by two mattress stay sutures, the ends of which were left long. The heart was carefully examined for further injury, and none found. During the entire procedure, the heart's action was regular, and no undue manipulation was made. The pericardial sac was carefully cleansed, and the incision sutured with continuous catgut suture, leaving a small opening through which a gutta percha drain was placed. The long ends of the stay sutures were brought through the pericardium and were tied over it, hoping in this way to strengthen the wound in the heart. Fine chromicized catgut was the suture material used.

In the chest cavity old pleural adhesions were found, which not only prevented the lung from collapsing, but also made it difficult for the blood to enter the pleural cavity. Drainage of the cavity was, therefore, not indicated. The osteoplastic flap was put in position, and the bones approximated. The pleura and muscular structures were sutured with catgut and the skin with interrupted silkworm gut sutures. A small gutta percha

drain was placed in the stab wound. The anæsthetic was discontinued when the operation was started and was therefore reduced to the minimum amount. The operation was performed in forty-five minutes. When he was placed in bed, his pulse was weak but regular. His record was, pulse 132, respiration 22, rectal temperature 99.8 degrees F.

Postoperative Course.—On the day following the operation the temperature rose to 102.4 degrees F., respirations 42, and pulse rate 120. He was restless and small doses of morphine were given to quiet him. He explained that at the time of admission to the hospital he had a slight cough, and it became evident that a bronchopneumonia had developed in the left lung. The symptoms of pneumonia were present during the first week, but the patient complained of little distress. The drain in the wound had been removed on the second day, the wound itself practically healing by first intention. After the first week the patient felt well and comfortable. After the second week he was practically well, but was not allowed to leave the bed until the end of the third week. His temperature, pulse and respiration were normal.

Frequent auscultations of the cardiac area were made, but the heart sounds were always normal. There was also no evidence of pericarditis. Sphygmograms were made and in each case the tracings were normal. An examination of the skiagraph of the chest shows perfect apposition and union of the severed ribs.

The patient suffers no inconvenience or distress as a result of the operation. He has since been hunting and fishing, and in a recent communication states that he is strong and in good health (Fig. 1).

From a study of these cases and a review of the literature on the subject of surgery of the heart, one must be convinced that injuries to the heart can no longer be considered as invariably fatal, but that the heart may be manipulated and treated surgically just as any other organ of the body. In the treatment of these injuries it is well to bear in mind certain observations that have been made in regard to the nature of the wounds, the process of repair, the method of surgical attack, and the complications that may arise.

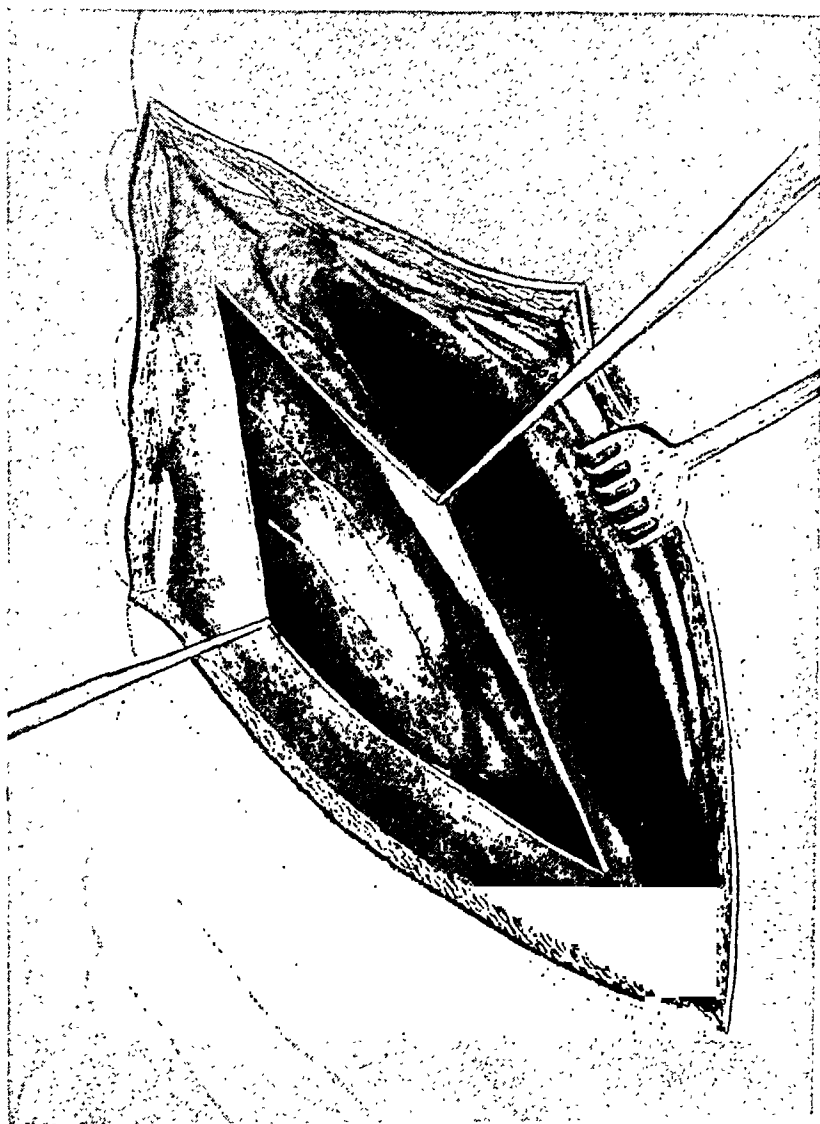
The principal injuries to which the heart has been subjected are those which resulted in puncture wounds, stab or incised

FIG. 1.



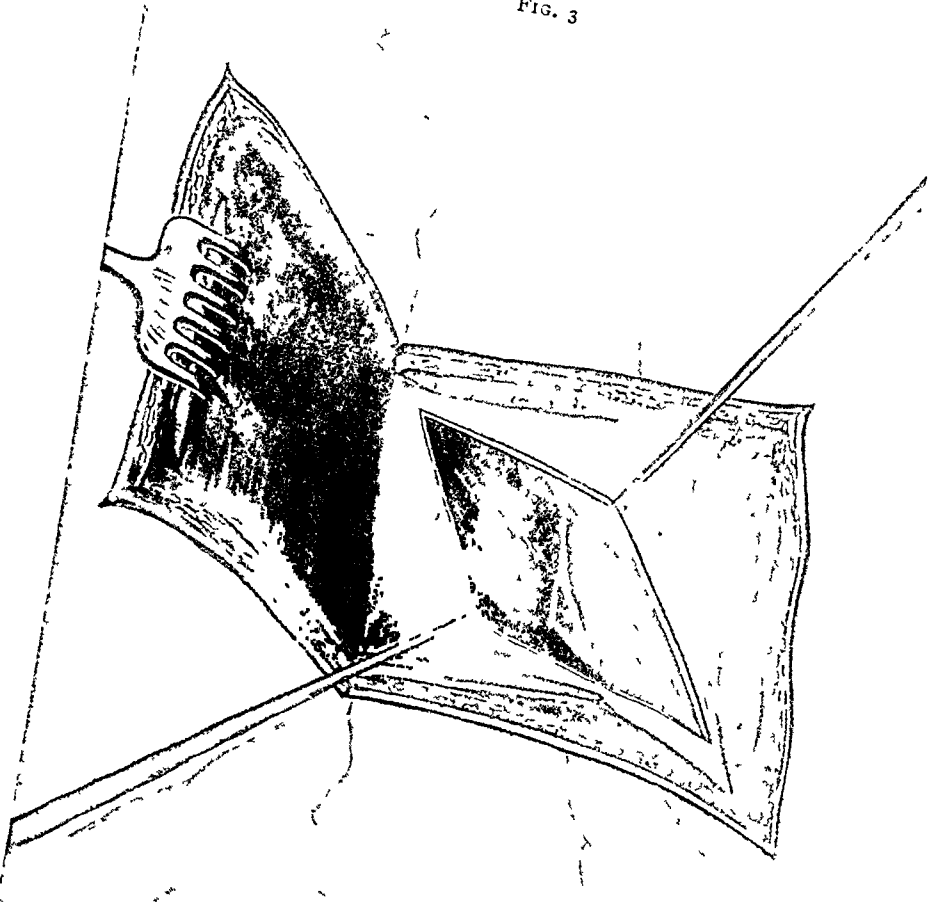
Case II. Penetrating stab wound of the left ventricle of the heart, with recovery of the patient. (Author's case)

FIG. 2.



Osteoplastic flap made by modification of Spangaro's intercostal incision, giving complete access to the heart for operations on the ventricles. Pericardium opened

FIG. 3



Sternal flap used in the interpleural route to expose the mediastinum and of service in wounds of auricles and vessels at base of heart Right auricle exposed

wounds, gunshot wounds, or lacerated and contused wounds. Small wounds of the heart may prove fatal, but many heal without complication. Sudden death may result by injuries which involve the bundle of His, but the heart may without serious consequences be subjected to a greater degree of injury and manipulation than is usually supposed.

The great danger in injuries of the heart lies in the resulting hemorrhage which usually proves fatal. If the myocardium alone is involved, the bleeding may be profuse, but it is usually greater when the cavities of the heart have been invaded. Wounds of the auricles bleed more profusely than those of the ventricles, the tendency of the muscular contractures of the ventricles being to close the opening and thus to limit the hemorrhage. With certain incised wounds of the ventricles, where the cavities were penetrated, blood spurted from the wound only near the termination of the systolic contraction. The amount of hemorrhage depends upon the blood pressure, the size of the wound and the contractile force of the heart-muscle.

Small wounds of the heart, even if they involve the ventricles, may heal spontaneously. Healing of heart-wounds takes place by cicatrization and the better the approximation the stronger the wound. Investigators have demonstrated that when the wound is properly approximated a true myocardial regeneration takes place. In wounds that are weak or in wounds incompletely healed, aneurism of the heart and rupture are apt to occur, and it is therefore safer and better surgery to suture all serious wounds of the heart than to trust to spontaneous closure.

In wounds of the heart the pericardium often plays an interesting and important part. If the rent in the pericardium is large, the sac may distend but moderately with blood and blood clots, hemorrhage taking place either externally or into the pleural cavity. When the flow from the pericardial sac is impeded, the sac will become distended and hemopericardium results. Then the intrapericardial tension increases and heart tamponade results. The effect of this tension is felt first on the auricles, whose function is so

impaired that the ventricles receive an insufficient supply of blood for the needs of the system. The heart's action becomes irregular, labored and weak, and may cease entirely. The effect of heart tamponade can easily be detected by the pulse. When, after short duration, the blood or clot in the pericardial sac is removed the activity and rhythm of the heart is usually restored.

The symptoms of a wound in the heart are usually those of hemorrhage and shock. The patients are, as a rule, not conscious of the wound in the heart and suffer more from the effects of the injury. They are anæmic, restless, and anxious, and the body is cold and clammy. If they have lost much blood, they may be semiconscious and usually complain of thirst. The pupils may be widely dilated. The pulse may be weak, irregular or imperceptible. If heart tamponade is present, the volume, quality and rhythm will vary from time to time, giving one the impression that the heart is laboring under great difficulty. The respiration may at first be but little altered, but when the lung has been injured there is usually bloody expectoration. In stab wounds the diagnosis may frequently be made from the location of the wound and the character of the symptoms. However, in gunshot wounds the diagnosis may be more difficult. When the pleural cavity has been penetrated a pneumothorax results and the air will be forced through the wound. Emphysema of the chest wall may result, and sometimes a portion of the lung itself escapes through the opening in the chest. When the pericardial sac is but partly filled with blood, a splashing sound may sometimes be detected. The presence of blood in the pleural cavity may be detected by the usual signs of fluid in the chest. The diagnosis is confirmed by exploration of the wound with the sterilized finger or by exploratory pericardiotomy. The size of the external wound may be no index of the nature of the wound in the heart.

All wounds of the heart should be considered as serious, and death is due usually to shock and hemorrhage. When the peritoneal cavity has been invaded, and there is injury to abdominal viscera, the prognosis is extremely grave. In a

list of one hundred and sixty tabulated cases, Peck records a total of one hundred and two deaths and fifty-eight recoveries, a mortality of 63.7 per cent. It is to be hoped that with improved methods of technic and a more thorough understanding and appreciation of the nature of wounds of the heart the mortality rate may be materially reduced.

In the treatment of wounds of the heart we should carefully consider the patient's immediate condition (shock and the effect of hemorrhage), the nature of the operation, the sources of infection, and the remote results. Great stress should be placed on the treatment of shock, which in these injuries is usually accompanied by great hemorrhage. The patient should be wrapped in hot blankets, and if restless he should be given sedatives (morphin) in small doses, repeated if necessary. The nature and extent of the injury should be definitely ascertained by exploration of the wound with the finger. The sense of touch is essential in determining the location and extent of the injury, and the finger serves a better purpose than surgical instruments. In suspected injuries to the heart, *it is safer and better to perform exploratory pericardiotomy than to run the risk of a fatal cardiac hemorrhage.* It should be remembered that strict asepsis is essential in the treatment of these wounds, and frequently the fate of the individual is sealed by the one who first examines the case. The location of the wound in the heart (auricular or ventricular) should, if possible, be determined so that a definite plan of operation may be decided upon. If heart tamponade exists, the condition should be relieved at once, either by following up the wound into the pericardial sac with the finger and letting out the blood, or by pericardiotomy. With the exploring finger the border of the heart should be located and definite information as to pneumothorax should be ascertained. Direct exposure of the wound in the heart is of great value, and the opening in the chest should expose the heart sufficiently to permit of satisfactory manipulation if necessary. If the wound is mediastinal and the pleural cavity has not been involved, we should be careful to avoid these cavities in opening the chest. The tissues should be carefully

pushed from beneath the sternum and ribs with the finger, which should serve as a guide in outlining the flap. If the pleural cavity has been penetrated, less care is demanded inasmuch as a pneumothorax already exists. The nature and position of the wound thus often determines the location and character of the opening to be made in the chest. The pericardial opening should usually be enlarged to permit of easy manipulation and inspection of the heart. Stimulants and intravenous or subcutaneous injections of saline solution should not be given, as a rule, until methods of arresting hemorrhage are made possible. They are of special value when the loss of blood has been great. Time is an important factor in these cases and the operation should be done as promptly and quickly as possible.

In most cases the operation is complicated by pneumothorax and the respiratory function is greatly impaired. When the patient is unconscious the operation may be performed without an anæsthetic. If a general anæsthetic is to be used, ether will be found safer than chloroform, and usually but little anæsthesia should be used after the chest has been opened. Local anæsthesia is unsatisfactory and may be dispensed with. By the administration of morphine and atropine a few minutes before the anæsthetic is started, the amount of ether is materially reduced and the danger of post-anæsthetic pulmonary complication is lessened.

The cases are at times so desperate that while under observation or at operation the heart stops beating. When the heart has been arrested for a very short period and other signs of life have apparently disappeared, the heart has been encouraged to resume its contractions by gentle compression and massage of the organ. It seems also that the blood supply to the organ itself, as indicated by blood pressure, and the quality of the blood, are of great importance in maintaining and controlling the heart's action. Therefore, artificial respiration should always be combined with heart massage and efforts be made to raise the blood pressure.

At operation it occasionally happens when the heart is quickly lifted or manipulated that pulsation suddenly ceases.

This happened in Case I and seemed to indicate that reflex action was an important factor concerned with the heart's action. By gentle compression, however, the heart was encouraged to resume its pulsations. However, in many cases, the heart's action appears to be independent of the general nervous control and the heart seems to have the power and stimulus within itself to produce rhythmic contractions. In the treatment of these cases we should, therefore, not forget the value of heart massage as an aid in resuscitation.

The wound in the heart having been located, the method of approach through the chest wall must be determined, and for this purpose a variety of flaps have been used. A wound in the heart has been sutured through a wide intercostal space, but usually this is not possible. The flaps that have been mostly used open to the right or to the left, and are either entirely on the left side of the chest or extend across the sternum. The object should be to so construct the flap that easy access to the wound in the heart may be had with the least damage to the chest wall and the pleural cavities. The flap should be made with the finger in the wound as a guide, and this is especially necessary if the pleural cavities have not been invaded.

When the wounds involve the left pleural cavity, Spangaro's intercostal incision, with extension upward or downward along the margin of the sternum as seems necessary, is the one of choice (Fig. 2). This incision is made in the fifth or fourth left intercostal space. By retraction of the ribs a view of the pericardium and pleural cavity may be had. If further space is desired after double ligation of the internal mammary artery, the incision may be extended upward or downward and the cartilages divided with costotome near their sternal attachments. The pericardium may be easily incised and wounds of the right and left ventricles can readily be repaired. If still more space is desired for the suture of wounds of the auricles or vessels at the base of the heart, the sternum may be divided, best with costotome, after separation of the underlying tissues, and forcibly turned to the right, making a hinge along the right costal attachment.

Care must be taken not to enter the right pleural cavity, or else a fatal double pneumothorax may result.

If a mediastinal wound is present and neither pleural cavity has been invaded, a flap involving the sternum with hinge along the right costal attachment is preferred (Fig. 3). This flap is of service in operations at the base of the heart. The underlying structures must be carefully separated from the under-surface of the sternum and ribs, so that the pleuræ may not be injured.

A flap with hinge internal involving cartilages and ribs as used in Case II (Fig. 1), is of service in those cases in which there has been a pre-existing pleurisy and in which the lung is bound by adhesions. These adhesions prevent collapse of the lung in pneumothorax and should not be disturbed. This flap gives ample room for manipulation of the heart, but if more space is desired, the incision may be extended across the sternum with hinge at the right costal attachment.

In persons with narrow and long chests, the flaps may be somewhat atypical and in certain of these cases the heart is more centrally located. In these cases it may, therefore, be necessary to use flaps involving the sternum.

The hemorrhage from the wound in the heart is temporarily best controlled by placing the finger in the wound. In incised wounds if tenaculum forceps or traction suture be placed at one end of the wound and the heart be permitted to pulsate while thus suspended, the traction and muscular contractions tend to close the wound and limit the hemorrhage. It has been found that by this suspension it is easier to suture the heart wounds than if the heart were held in the hand. Interrupted silk or catgut sutures may be used. The sutures should be deeply placed, but not to include the endocardium. In large wounds there seems to be an advantage in fastening the pericardium over the wound, as this by adhesion strengthens the wound and may tend to prevent aneurism or rupture. Before closure of the pericardial sac, a careful search for multiple injuries should be made.

Inasmuch as many cases in which the heart has been sutured die from infection of the pericardium or pleural

cavity, the matter of drainage has received special consideration. That this infection may be unavoidable and introduced at the time of injury, there can be no doubt. It seems to be a wise plan to consider penetrating wounds as infected wounds and to promote drainage in these cases. Drains that do not drain are harmful, and often a gauze drain serves merely as a plug to enclose infection. Drainage can only well be accomplished when the external wound is kept open so that infectious material may be discharged through it. There must be an avenue of least resistance for the discharge of infection. If drainage is to be instituted, the external wound should be kept open. Rubber tissue as a drain will permit the discharge of infectious material and will not plug the opening. In my own experience, I have found it best to drain the dependent portion of the pleural cavity when infection was anticipated. The pleural cavity, especially if the lung is partially collapsed, does not well resist infection and therefore early drainage is desirable. It seems advisable not to completely close the pericardial sac, so that accumulations of fluid or infections may be discharged and not collected in the sac. It is a wise plan not to close the traumatic wound, but to leave it open for drainage. After all, the manner of drainage is governed largely by the results of personal experience.

In closing the wound catgut will be found best for the pericardium and muscular structures. It is safer not to close the skin wound too tightly, but to approximate the edges with interrupted sutures, leaving ample opportunity for drainage.

The chief postoperative complications are those associated with shock and hemorrhage, pneumothorax, pneumonia, and infection of the pericardium and pleura. Secondary hemorrhage occasionally takes place and may prove fatal. Embolism also occurs, but not as frequently as may be supposed.

If the loss of blood has been great and the hemorrhage has been controlled, the extremities should be bandaged to confine the circulation. Saline solution, intravenously, by hypodermoclysis, or proctoclysis should be given, or better, if possible, direct transfusion of blood. One should guard against anæmia of the brain, the effects of a lowered blood

pressure, and an over-distended heart. Diffusible heart stimulants are indicated, and the restlessness should be controlled by small doses of morphin. The urinary and intestinal tracts should also receive careful attention.

CONCLUSIONS.

The heart may be manipulated without serious injury to the organ and is amenable to surgical interference and procedure.

Hemopericardium with heart tamponade is a serious complication and demands prompt drainage of the pericardial sac.

In suspected injuries to the heart, the wound in the chest should be carefully explored so that the extent of the injury may be determined, and in cases of doubt, exploratory pericardiotomy is indicated.

Small wounds of the heart may heal spontaneously, but in all cases where hemorrhage from the heart exists, the wound should be promptly sutured.

In operations upon the heart when pulsations suddenly cease, massage of the heart and artificial respiration should be tried as aids in resuscitation.

With a minimum amount of anæsthetic the healthy lung is capable of performing its function, though to a less extent, even when the pleural cavity is exposed.

Time is an important factor in injuries to the heart, and an early diagnosis should always be made. The immediate treatment should be directed to the control of hemorrhage and shock. The chief remote complications result from infections of the pericardium and pleura.

In treating injuries to the heart, the surgeon should have in mind a definite plan of attack, and the kind of a flap to be used in approaching the heart should be determined by the nature of the wound in the chest.

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ABNORMAL POSITION OF THE DUODENUM.*

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THE duodenum is singularly constant in its relations, course, and length. Any exceptions are exceedingly rare and worthy of note. The anomaly that I wish to report was found in the person of a patient who was being operated upon for gastric ulcer.

The duodenum ran to the right and then turned downwards external to the hepatic flexure, ascending colon, and cæcum, and, merging into the jejunum, passed from without inwards below the cæcum into the small intestine area. The duodenum was completely surrounded by peritoneum. It had a long mesentery throughout, and could easily be held two or three inches in front of the abdominal wall. The head of the pancreas, closely applied to the duodenum, was visible and palpable between the layers of the duodenal mesentery, and readily followed the duodenum when the latter was brought outside the body.

Instead, therefore, of passing across the second lumbar vertebra and behind the transverse colon and superior mesenteric artery, it retained an early embryological position. There was, of course, no ligament of Treitz and no fossa duodenojejunalis. The condition is clearly one of arrested development. The cæcum in this case did not mount upwards to the lower hypochondrium, and did not pass in front of the loop of the duodenum. The cæcum did not descend to its usual final resting place in the right iliac fossa. It was high, completely surrounded by peritoneum, and very movable and could be brought out through the epigastric incision and held eight inches in front of the body.

* Read before the American Surgical Association, May 3, 1910.

The patient, a lady fifty years of age, had suffered from indigestion for about eighteen months. Her symptoms consisted of pain that appeared three or four hours after eating. The mid-day and evening meals were generally vomited. She had lost thirty pounds in four months. She had never vomited long retained food nor blood. The stomach was considerably dilated, and the diagnosis was dilatation due to benign pyloric obstruction.

There was no ulcer about the duodenum or stomach antrum. One ulcer was visible and palpable on the anterior wall of the stomach midway between the lesser and greater curvature, over the lower part of the fundus. A crater-like ulcer on the posterior wall of the stomach was adherent to the transverse colon. The colon and stomach were separated. The bared surface of the colon was infolded. The stomach ulcer was excised and the wound closed. The ulcer on the anterior wall was also excised and the wound closed.

Recovery was uneventful. The patient has regained health and is now very well.

The normal changes in the position of the duodenum are very clearly described by Mr. Treves (now Sir Frederic Treves), in a paper which he published in the *British Medical Journal*, on August 28, 1885. "In its primitive condition the alimentary canal appears as a simple vertical tube, running down in the middle line, and connected to the spine by a simple vertical fold of peritoneum. In a little while, the upper part of the tube enlarges and becomes bulbous, and the rudimentary stomach is produced. The lower part of the tube retains its primitive connection with the spine, and retaining also very nearly its original vertical direction, becomes the descending colon and rectum, including a part also of the transverse colon. In fact, it persists as all that segment of the large intestine that is supplied by the inferior mesenteric artery. The intermediate part of the primary tube increases rapidly, and soon forms a large loop, which projects out of the still shallow abdominal cavity, and from which the intestine from the pylorus to about the middle of the transverse colon is ultimately developed. There is at first nothing to

indicate the separation of the large intestine from the small, but soon a bulging takes place at a point just behind the apex or middle of the loop, and this, in process of time, develops into the cæcum and its appendix. This large loop has a common mesentery, continued from the original vertical mesial fold of serous membrane that connected the primary intestinal tube with the spine. The loop has a narrow neck, formed above by the duodenum and below by that part of the large intestine that subsequently becomes the right extremity of the transverse colon. Between these two segments of gut, at the neck of the loop, the superior mesenteric artery runs to supply the bowel. As it runs in the mesentery, it gives off branches from its right or upper side to supply the small intestine, while from its left border arise the vessels for the cæcum and ascending colon. The intestine in the loop grows rapidly, and the mesentery increases in a corresponding ratio. That part of the membrane, however, that lies at the neck of the loop does not grow at the same rate. Thus it is, as Professor Flower has well pointed out, that the duodenum and the right end of the transverse colon never lose their primitive relation, in spite of the many subsequent changes that take place in the position and growth of the viscera. They continue to limit and bound the neck of the mesentery, and, as growth proceeds, this neck or root becomes proportionally narrower, while through it still runs the trunk of the superior mesenteric artery. In time, the great loop is withdrawn into the abdomen, and becomes twisted upon itself in a remarkable but definite manner. This twisting is due, in the main, to unequal growth in the two sections of the loop; for, while the small intestine has been increasing in length with great rapidity, the colon has comparatively grown but little. Just before the twist takes place, the cæcum will probably be lying about the umbilicus, and will be placed, together with the rest of the large intestine, wholly to the left of the middle line.

“When the change in position occurs, the cæcum mounts up towards the right hypochondrium; it passes in front of the loop of the duodenum, and ultimately descends to its

final resting place in the right iliac fossa. As a result of the twisting, the small intestines are turned towards the left side; what was originally the right side of the mesentery becomes the left side; and the vessels to the small intestine are seen to come off from the right border of the superior mesenteric artery, instead of from the right. The mesentery has been rotated, in fact, half a circle. At the narrow neck of the great loop the changes are less conspicuous. The right end of the transverse colon has passed in front of the duodenum; but they still form the boundaries of the narrow neck of the mesentery, and between them still passes the superior mesenteric artery. As development proceeds, the bowel grows somewhat out of proportion to the peritoneum about it, and this disproportionate growth is well marked in the two segments of bowel that form the neck of the great intestinal loop. As they grow, they become too large for these serous coverings, they to a great extent grow out of them, and thus it happens that the duodenum and transverse colon are brought nearer and nearer together, until at last their relations are very intimate, although their mutual positions have become modified. The development of the duodenum itself may now be considered. This part of the gut forms a loop of its own; a loop that starts from the pylorus, and ends where the gut becomes fixed by the musculus suspensorius. Its termination, therefore, is at the neck of the great general intestinal loop and close to the trunk of the superior mesenteric artery. The duodenum, which is at first comparatively of large size, has its own mesoduodenum, which is attached vertically to the middle line, being a part of the original mesial mesentery. When the pylorus moves to the right, the loop of the duodenum moves with it, so that the left layer of the mesoduodenum becomes anterior and the right layer posterior. When the twist takes place in the intestinal loop the duodenum has no share in it. The general position of the loop remains unchanged. The end of the duodenum is dragged across the middle line from the right side to the left, the superior mesenteric artery passes over it instead of by its side,

the dragging produced by the upward movement of the colon causes the terminal part of the duodenum to become vertical, and a sharp twist is formed in the gut where the duodenum and jejunum meet. The mesoduodenum and the mesentery are no longer continuous in the same plane. In time, the duodenum loses its mesenteric fold, partly because it grows out of proportion to the peritoneum and partly because developing viscera in the neighborhood draw the serous covering from it, and ultimately it actually acquires a large non-peritoneal surface."

END-TO-END INTESTINAL ANASTOMOSIS BY THE INVAGINATION METHOD.*

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ATTEMPTS to obtain end-to-end reunion of a severed intestine by invaginating one end into the other have been described since the earliest history of intestinal suture. Beginning with Jobert and Ramdohr all kinds of modifications have been practised; but it is fair to say that to-day intestinal reunion based on such a procedure does not occupy a definite place in the technic of intestinal surgery. The method which I venture to present has no pretension of competing with conventional methods; but it is believed that it is useful in certain difficult cases of reunion of the large intestine where other methods would ordinarily be impracticable or predestined to failure.

I first had occasion to employ it in a crude form in 1904; the report is briefly as follows:

CASE I.—Nellie W., 33, colored; operated on in St. Luke's Hospital December 19 for double pyosalpinx. The operation presented unusual difficulties, and at its termination it was seen that about six inches of the upper part of the rectum had been completely denuded of its peritoneum and its vitality obviously jeopardized. Ordinary resection being judged impracticable, the gut was divided at the lower end of the denudation. A long pedicle clamp was then passed through the anus and made to grasp the upper segment and pull it through the lower end down as far as it would go—nearly to the anus, where it was maintained by fixing the clamp in position. Two or three sutures were introduced at the point of contact of the two segments to ease the tension on the clamp. At that

* Read before the American Surgical Association, May 4, 1910.

time the idea that one could deliberately make a satisfactory suture which could be depended on alone did not occur to me.

To my astonishment the patient made an uninterrupted recovery. The clamp was removed in two days; fæces were passed normally *per anum*; there never was any leakage, as we could easily convince ourselves, the wound having been only partially closed as a precautionary measure.

In June, 1909, in the course of a panhysterectomy for fibroid uterus and a complex intraligamentous cyst, in order to make a clean enucleation I had to do deliberately what I had done inadvertently before—denude the rectum to a dangerous extent. This time I determined to make a careful and systematic reunion according to the technic to be described later.

CASE II.—Mrs. O., 26; operation in St. Luke's Hospital, June 10, 1909.

The denuded rectum was divided as described in Case I. About five inches of the denuded upper end were passed down into the cavity of the lower end, and approximation of the two portions at the neck was performed by some interrupted silk sutures completed by a superimposed continuous suture. The vagina was left open and gauze packing was placed in the cul-de-sac.

The patient made a good recovery; the suture was, however, not perfectly tight as for a few days there was some fecal soiling of the packing. Discharged July 11, well healed and having natural movements. Remains under observation and continues in excellent condition, particularly as regards the bowels, an obstinate constipation existing before operation having disappeared.

Encouraged by these results I decided on this procedure as the method of choice in two resections of the rectosigmoid junction for carcinoma.

CASE III.—Mrs. J., 53. Operation in St. Luke's Hospital, June 15, 1909. Extensive involvement of the sigmoid and a loop of small intestine by contact. Resection of sigmoid and

twelve inches of the ileum. Reunion of the colon as described in Case II. Patient succumbed three days later. Post-mortem examination of the wound showed no peritonitis or suspicion of fecal extravasation.

CASE IV.—Mrs. R., 49. Operation at St. Luke's Hospital, December 10, 1909, for intestinal obstruction of twelve days' standing. Median laparotomy disclosed a small annular carcinoma at rectosigmoid junction. Cæcal anus established by a small incision in the right linea semilunaris. Twelve days later resection of the carcinoma, end-to-end anastomosis by invagination. Successful result, but some infection of the abdominal wall by a minute leakage which persisted only twenty-four hours. The cæcal fistula closed spontaneously within a few days. Remains under observation, is in good health, and bowels move regularly.

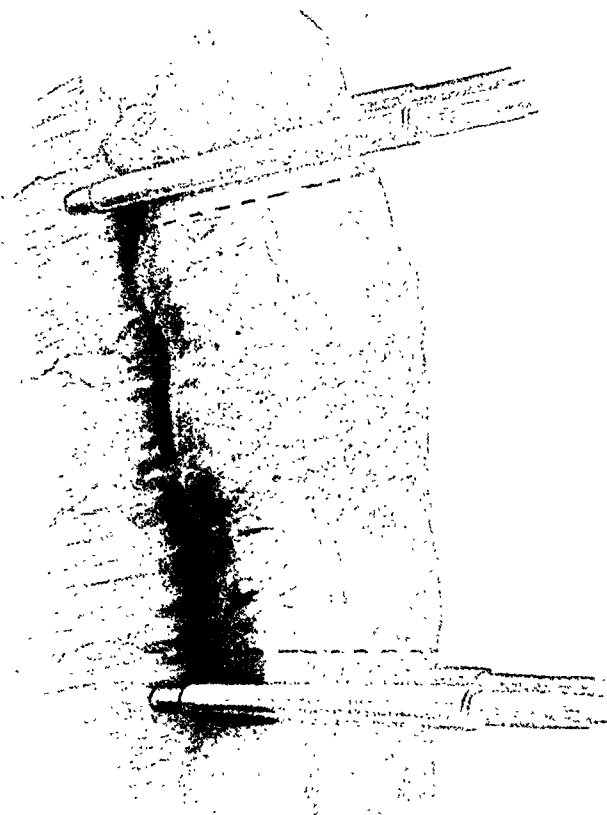
During the summer of 1909 Dr. H. K. Kellogg conducted some experiments for me on dogs, which gave us also the opportunity to investigate the possibility of using this anastomosis in the small intestine, and it was found to work well; but its usefulness is perhaps more evident in the large intestine, where end-to-end union is so apt to be imperfect even in the hands of the most competent. I believe that if lateral anastomosis is impossible after resection of the colon, the method here described will be found the next best. It has also an undoubted superiority over lateral anastomosis in its simplicity and requires much less time for its performance.

Technic.—The technic here described is based on the knowledge accumulated in the cases just described and the animal experiments performed in the Loomis Laboratory of the Cornell Medical College.

Usual preparation and incision of the abdominal wall at the most suitable point. Temporary occlusion of the gut by clamps.

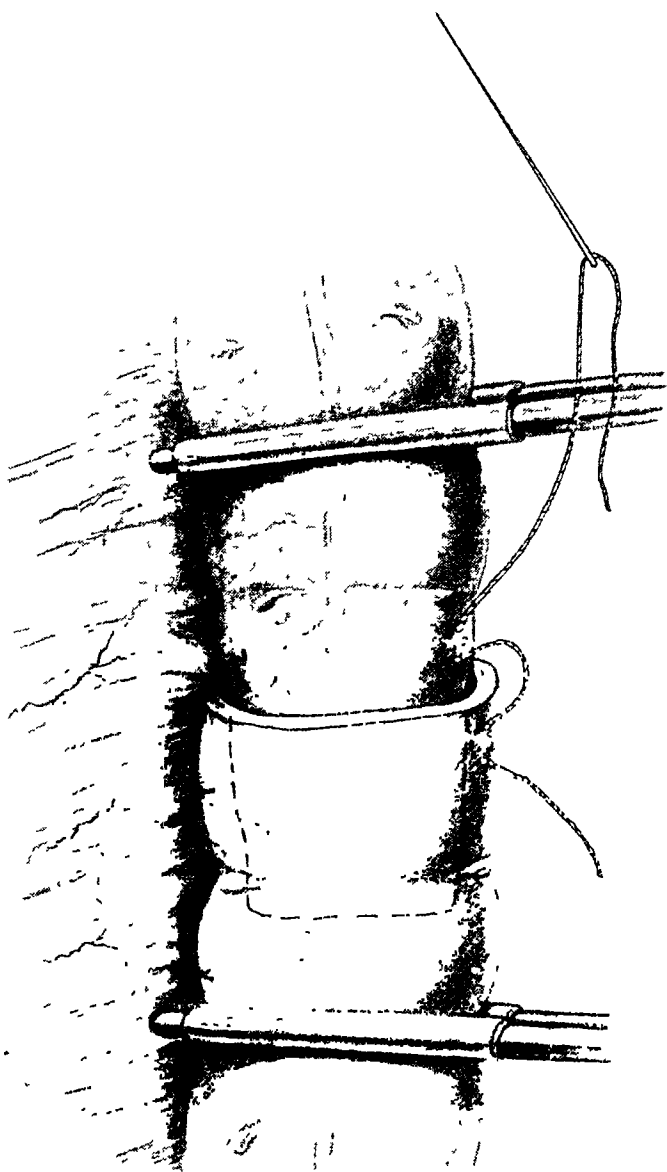
The upper cut edge of the gut is seized with two Kocher clamps and introduced by these into the lumen of the lower end and maintained there by an assistant. The extent to which it is feasible to accomplish this invagination will vary,

FIG. 1.



Preliminary clamping of intestine before its division.

FIG. 2

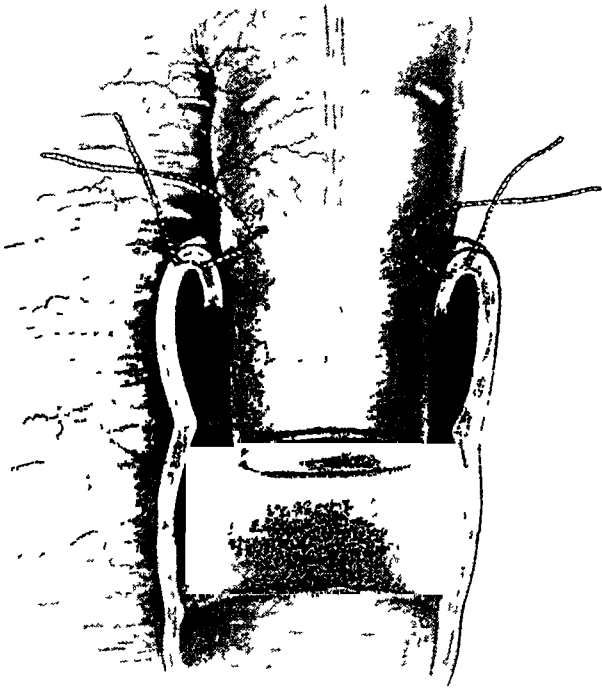


Upper segment telescoped into lower. First suture introduced.

FIG. 3.



Shows invagination of edge of lower segment, burying the two peritoneal surfaces into contact



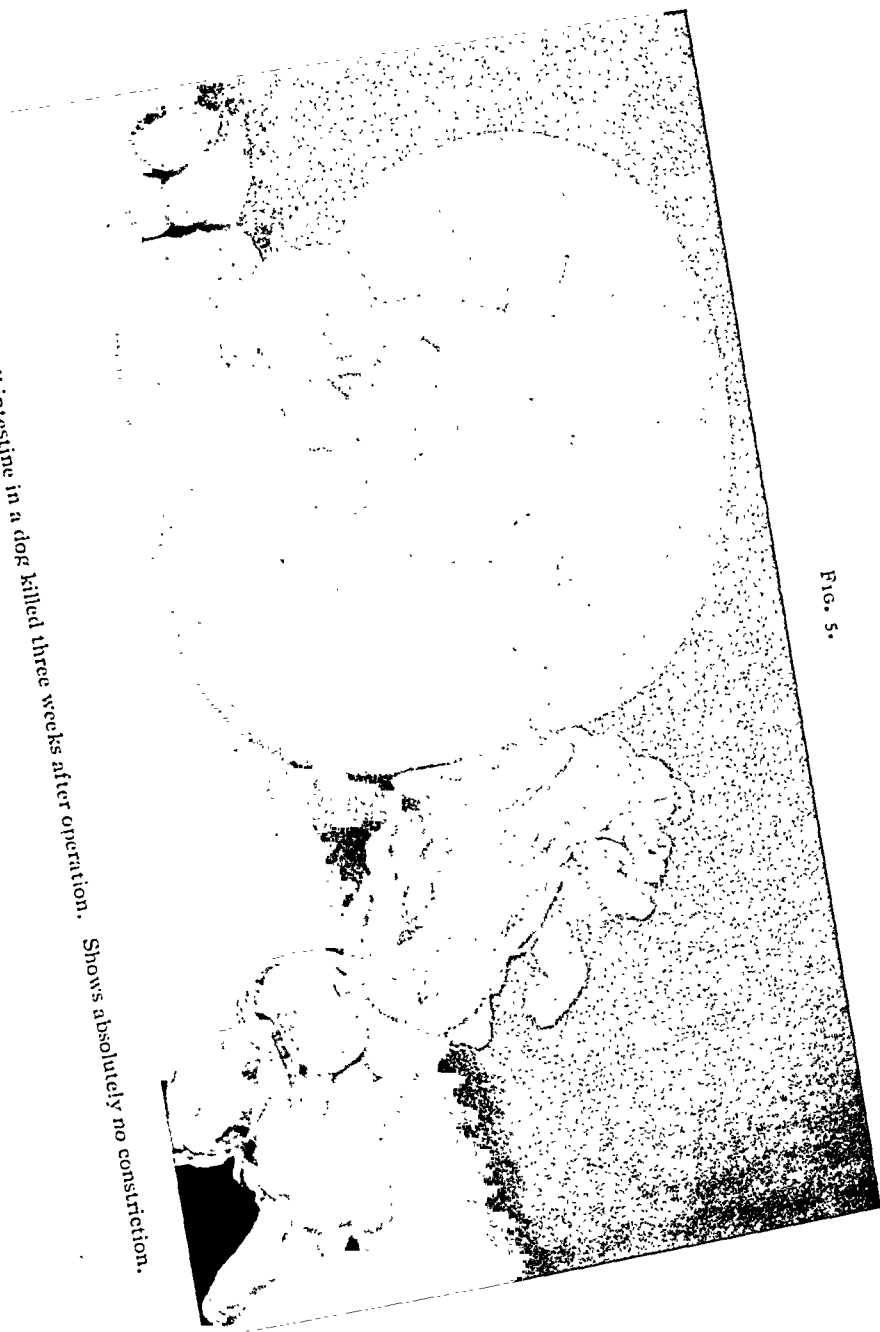
Interior view of the invagination

FIG. 6.



or view of ti

FIG. 5.



Resection of small intestine in a dog killed three weeks after operation. Shows absolutely no constriction.

depending on the laxity of the mesentery. If the latter is very short, it may be elongated somewhat by a generous incision of its outer layer. As a general rule I should wish to carry the cut end of the upper segment so far down as possible, hoping more efficiently to direct the fecal current away from the suture line. The gut is rotated about a quarter circle so that the non-peritoneal covered surfaces do not entirely approximate in the circumference. Eight to twelve interrupted silk sutures are introduced thus. A Lembert suture is begun on the lower segment, the needle issuing just short of the cut edge; on the upper segment the needle is introduced just above the line where the cut edge of the lower segment lies against the intact wall of the upper. When the knot is tied the free cut edge has been turned inward and only the peritoneal surfaces are in contact. A continuous running suture is applied over this area, further invaginating the first ones, the Kocher clamps being previously withdrawn.

In the after treatment the bowels are not moved for three days and only a low residue diet is given.

Finally, I desire to call attention to the specimen of the resection of the small intestine in a dog. There is no narrowing of the canal, and this fact dismisses any theoretical arguments that might be raised. In the large intestine such a degree of stenosis, if any, is insignificant.

Since this paper was written, the procedure has been employed in two cases of gangrenous femoral hernia. One recovered fully, but the other died, peritonitis developing on the fifth day.

TRANSACTIONS

OF THE

AMERICAN SURGICAL ASSOCIATION.

Meeting held in Washington, D. C., May 3, 4 and 5, 1910.

OPERATIVE TREATMENT OF TUMORS OF THE HYPOPHYSIS.

DR. A. E. HALSTEAD, of Chicago, Ill., said that a survey of the literature on the operative treatment of tumors of the hypophysis discloses the fact that many of the procedures proposed are based not on clinical experience, but on observations made in the post-mortem room; therefore, the merits of these methods are still unproved. Halstead proposes what he terms the oronasal route, which he employed successfully in one case. It is a modification of the infranasal method of approach, but is without the trauma and disfiguration which must follow the Koenig operation.

He presented a man, showing the extremely good result obtained by this method of procedure. He also reported a fatal case.

OPERATIONS ON THE HYPOPHYSIS.

PROF. VON EISELSBERG, of Vienna, read a paper on Operations on the Hypophysis, for which see page 1.

DR. SAMUEL J. MIXTER, of Boston, followed with critical remarks and the report of a case, for which see page 15.

DR. HARVEY CUSHING, of Baltimore, said that the various means of approach to the hypophysis do not make so much difference as does the matter of dealing with the structure when it is brought into view. The growth often becomes malignant, as is true of long-standing trouble with the thyroid, and it is conceivable that it cannot be entirely removed. In fatal cases it has often been found that only a mere fragment of the growth has been taken away. The operation in the first place has for its object the relief of pressure; these symptoms can be combated by the mere removal of the lower part of the sella turcica and the splitting of the capsule of the gland. Whether many of

these adenomas are merely hypertrophies of the gland comparable to various diseased changes in the thyroid we do not know, but if so partial removal is indicated.

DR. A. B. KANAVAL, of Chicago, remarked, concerning the technical procedure in Dr. Halstead's cases, in the first one particularly, that the view could not have been better. The operation was very quickly done, the anterior wall of the sphenoidal sinus quickly removed, and the bulging sella turcica opened, and a tumor protruding into the sinus was removed without difficulty. In the second case the sella turcica did not bulge into the sinus, it was seen with more difficulty, and was arrived at by anatomical deductions. In both cases there was considerable hemorrhage and he would suggest the elevation of the head during the operation. In the majority of cases it will only be necessary within the nose to remove the vomer and the anterior portion of the sphenoid in order to reach the sella turcica.

DR. DEAN LEWIS, of Chicago, said that the tissue removed from the first case contained no elements which are ordinarily found in the anterior lobe or the pars intermedia. The tumor was composed of stratified epithelium with a papillary arrangement. The lower cells rest upon the stroma of the papillæ and are cylindrical, while the cells of the succeeding layers differ in shape; the difference apparently being due to variations in pressure. As the cells of the anterior lobe and the pars intermedia are not reproduced in this growth, we must assume that the tumor has probably developed from an epithelial inclusion, which has not gone on to complete differentiation. The growth corresponds histologically to a group of tumors which occur about the infundibulum and extend down to the sella and up to the third ventricle.

The tissue removed from the second case came from the anterior lobe. In some sections the cell columns are cut parallel, long rows of cells resting between rather thick connective-tissue trabeculæ. In other fields the cell columns are larger than normal; the connective tissue between the different columns having broken down, thus permitting of fusion. In still other fields the fusion has become so marked that large groups of cells are found, hyperplasia apparently having ended in adenoma formation. Karyokinetic figures may be seen in a number of different fields.

It is important to recognize the complex structure of the

hypophysis in making the anatomic diagnosis of tumors of this gland, and to remember that the cells of the anterior lobe, when growing rapidly, tend to reproduce the structure of a sarcoma. Stains which differentiate granules should therefore be used in the study of all growths apparently originating in the hypophysis.

BENIGN BONE CYSTS, OSTITIS FIBROSA, GIANT-CELL SARCOMA, AND BONE ANEURISM OF THE LONG PIPE BONES. A CLINICAL AND PATHOLOGICAL STUDY WITH THE CONCLUSION THAT CONSERVATIVE TREATMENT IS JUSTIFIABLE.

DR. JOSEPH C. BLOODGOOD, of Baltimore, read this paper.

DR. RUDOLPH MATAS, of New Orleans, related the history of a case in which after removal of a giant-cell sarcoma from the humerus there was such a large cavity that he used about an ounce and a half of Mosetig cement to fill it, and the patient later developed extreme symptoms of iodoform poisoning, as was but natural from the large amount of the cement used. In ten days, however, he recovered from its effects and the arm healed with a perfect contour of the bone. Beck's paste promises to be a most valuable means of filling up bone cavities.

DR. WILLIAM L. RODMAN, of Philadelphia, recalled a case operated upon in 1889 for large giant-cell sarcoma of the lower jaw by free chiselling and curettement but without removal of the maxilla. The patient lived for more than ten years after this operation, and may be alive to-day.

DR. JOSEPH A. BLAKE, of New York, had a case of sarcoma of the bone, the fourth finger of the patient being diseased. A simple operation in this case proved most satisfactory, and now, three years since operation, there is a normal phalanx.

DR. HARRY M. SHERMAN, of San Francisco, said that in his experience salt solution poured into these cavities a little in excess just before the last stitches are taken is as good as any other material for filling; it is replaced by blood, and obviates the necessity of putting in any foreign body such as iodoform or bismuth.

DR. DUDLEY P. ALLEN, of Cleveland, said that some years ago he removed the lower jaw of a patient for giant-cell sarcoma, leaving but a small portion of the substance of the jaw. He used a splint to hold the teeth in place. The patient recovered entirely and is now well.

DR. WILLIAM S. HALSTED, of Baltimore, was reminded of a

patient with a myxoma of the humerus; although the disease involved the bone from one end to the other there was no cyst and no fibrous tissue. The bone was excised excepting for a strip posteriorly and at the lower end, and the entire cavity carefully swabbed out with carbolic acid. The patient made a good recovery and had a strong humerus, but there were implantation recurrences in the soft parts on two occasions. It has now been four years since the first operation and the patient at present is perfectly well.

DR. NATHAN JACOBSON, of Syracuse, in reference to giant-cell sarcoma of the jaw, recalled one case still living in whom he did a partial excision of the upper jaw for giant-cell sarcoma about 25 years ago. There was never any recurrence. In his experience, in those cases of giant-cell sarcoma where there is reasonable cleaning out there is seldom a recurrence of the growth.

PROFESSOR A. VON EISELSBERG, of Vienna, said that in such cases as these mentioned by the reader of this paper he was in the habit, before finishing the operation, of pouring boiling water into the wound in order to destroy all the germs, and had found it a most satisfactory method.

DR. JOSEPH C. BLOODGOOD, of Baltimore, in closing said that Dr. Halsted's case of exostosis with involvement of the humerus brings out the point that pure myxoma is a benign tumor, that recurrence after operation may be due not so much to leaving a portion of the tumor growth behind as to infecting the wound in removal of the tumor. In such cases it would be well to use boiling water, pure carbolic, or Paquelin's cautery to disinfect the wound.

REMOVAL OF A TACK FROM THE LEFT BRONCHUS.

DR. N. B. CARSON, of St. Louis, Mo., reported the history of a child, aged 4 years, who was brought to his service in the St. Louis Mullanphy Hospital, January 18, 1909. A month before entering the hospital she was supposed to have swallowed an upholsterer's tack, which was followed by a severe spell of coughing and later by a very serious illness. Physical examination showed the child to be very pale, anæmic, emaciated, and weak. She swallowed either liquids or solids with difficulty, and coughed almost constantly, with an expectoration of white mucus, and the coughing was accompanied by a very severe pain on the left

side of the sternum. The left lung was dull in the middle portion, while the upper and lower portions were more or less resonant.

A skiagraph of the chest showed the tack in the median line with the head down and the point upwards, the point being lodged in front of the body of the fifth dorsal vertebra. Examination of the sputum was negative, as was also Von Pirquet's test.

On January 27 tracheotomy was done, and an attempt made by means of the bronchoscope to remove the tack, which failed. On January 29 a skiagraph located the tack about the beginning of the left bronchus. January 30, under rectal anæsthesia, a section of about an inch of the seventh rib on the posterior line was removed, and an opening made into a small abscess cavity in the lung, which discharged about an ounce of yellowish pus. At the same time the bronchoscope was reintroduced into the tracheal opening, and the left bronchus was found to be entirely closed. On account of the inability to get permission to operate sooner nothing was done until July 27, when an opening was made in the chest over the sixth rib and about three inches of the rib removed and the pleural cavity opened. The lung was entirely solidified, and upon exploring the left bronchus at its entrance into the base of the lung an abscess cavity was located, which when opened discharged about a drachm of fetid pus. The tack was found in this abscess cavity and removed.

At 7.30 of the same evening there was a twitching of the left side of the face, arm, and hand, which was followed by a partial hemiplegia. After this the patient improved steadily until the evening of August 2, when there was a gush of blood from the nose and mouth which was speedily followed by death. Post-mortem showed that there had been an extensive inflammation involving the entire lung and the pleura of that side. Between the left bronchus and the pulmonary artery was an abscess cavity in which the tack had been lodged after it had forced its way through the bronchus. A small opening was found in the pulmonary artery as a result of the erosion caused by the head of the tack.

SURGICAL TREATMENT OF ŒSOPHAGEAL DIVERTICULA.

DR. CHAS. H. MAYO read a paper with the above title, for which see page 812, June, 1910.

DR. SAMUEL J. MIXTER, of Boston, said that he had operated upon three cases of Œsophageal diverticula. Where operation is

not done, it may be possible in some cases by the passage of very large bougies or probangs by means of a string guide to secure a sufficient dilatation of the spur to allow the passage of food sufficient to keep the patient alive. He had about half a dozen such cases.

DR. GEORGE W. CRILE, of Cleveland, reported that he had operated upon two cases of œsophageal diverticula, both of which recovered.

DR. JOHN B. MURPHY, of Chicago, said that the enucleation of the sacs of diverticula is not a difficult matter in itself, but it leaves a large cavity, and it is difficult to avoid the danger occurring from leakage at the suture, infection from the mouth, and particularly the action of the salivary glands upon the loose connective tissue of the mediastinum. He thought not opening the sac at all is the only safe procedure.

DR. GEORGE E. BREWER, of New York, called attention to one symptom in œsophageal diverticula which is characteristic, that is the presence frequently during the day, perhaps every hour or half hour, of an accumulation of thick, tenacious mucus which the patient will regurgitate to get relief. His own experience had been limited to three cases and one operation. This patient was a woman 80 years of age who had lost 50 pounds through starvation. She made a perfectly good recovery from the operation.

DR. DEFOREST WILLARD, of Philadelphia, remarked that surgeons should always remember the possibility of enlarged thymus in sudden deaths in young infants under ether. In such cases one is very likely to be misled by the statement that the child has swallowed some foreign body.

DR. WILLIAM L. RODMAN, of Philadelphia, believed that in cases of foreign bodies in the air-passages great risk is incurred in delaying the period of operation, and urged that all such cases be operated upon immediately upon being seen.

DR. NATHAN JACOBSON, of Syracuse, referred to a case of a 15 months' old child who swallowed a bean. By a tracheotomy the bean was gradually removed and the child made a good recovery. Regarding misleading histories, he was called to see a child suffering from complete obstruction of the trachea, supposed to be due to having swallowed a piece of bone. Subsequent history showed, however, that the child had inherited syphilis, and evidently had had gradually increasing disturbance,

and the history of the swallowing of the foreign body was purely an assumption.

DR. ALBERT VANDERVEER, of Albany, mentioned two cases bearing upon the subject of œsophageal diverticula, one in a physician who refused to have any instrument passed and who subsequently died of an acute pneumonia; the other occurring in a woman about 50 years of age. In this case it was impossible to get into the stomach with any form of instrument and he therefore did a gastrostomy and the patient made a good recovery. She now alternates between tube feeding and the natural method.

DR. JOSEPH RANSOHOFF, of Cincinnati, said that he had treated a case of abscess of the lung which lived four or five weeks after operation. The abscess was the result of the inhalation of a peanut shell.

He mentioned also a case of a foreign body in the air-passages which was unsuspected. Some two or three months after doing an intubation for laryngeal croup in a little child, the patient expectorated a small triangular tag such as is used to stiffen the corners of pasteboard boxes; the presence of this foreign body had not been suspected at the time of operation.

TESTS TO DETERMINE THE EFFICIENCY OF THE COLLATERAL CIRCULATION BEFORE ATTEMPTING THE PERMANENT OCCLUSION OF THE GREAT SURGICAL ARTERIES.

DR. RUDOLPH MATAS, of New Orleans, La., made an address on this subject, in the course of which he said:

The surgery of the vascular system bristles with problems which still await solution, but of these none is more important or fundamental than the study of the collateral circulation with the view of determining its efficiency in preserving the life of the peripheral parts before permanently obstructing the more important arterial channels of the circulation.

The knowledge of the efficiency of the collateral circulation is of special importance before undertaking the surgical treatment of the peripheral aneurisms or the removal of tumors which include the large vascular trunks of the regions involved, *i.e.*, thigh, popliteal space, upper arm, neck. The speaker reviewed a number of suggestions and methods by which the condition of the circulation in the peripheral parts, after the temporary occlusion of the main trunks, could be tested; but of these none

appeared to him more simple and satisfactory than a modification of the Moszkowicz test which he had devised and applied with much success in his practice.

If a popliteal aneurism be taken as an example of one of the more frequent types of aneurisms in which a knowledge of the peripheral circulation is desired, the author would apply his test as follows: The patient is placed in the recumbent position and the affected limb is exposed on a white sheet which will show the variations in the color of the skin to the best advantage. The operator should begin by determining the position of the femoral artery in Hunter's canal, as near the aneurism as possible, and then adjust the block of a mechanical compressor which is to rest upon the artery without compressing an area larger than is strictly necessary to obliterate the pulse in the aneurism and the pulse in the peripheral arteries (dorsalis pedis and posterior tibial). The best instrument for this purpose is the Massachusetts General Hospital compressor, designed originally (thirty years ago) as a substitute for digital compression. This instrument has now become obsolete, but for the purpose of this test it is most useful and satisfactory. After adjusting the block of the compressor upon the artery at a point nearest the aneurism, the circulation in the limb outside of the small area of localized compression should not be interfered with. Having determined the position of the vessel, the compressor should be tightened on the artery until the aneurism is "stilled" and all peripheral pulsations cease. When this is done, some significant changes in the appearance of the foot, toes, and peripheral parts will be noticed, but the test of the collaterals will really depend upon the appearance or absence of the "*hyperæmic blush*" which is obtained by a complete preliminary ischæmia of the limb. This is done by applying an Esmarch elastic bandage from the toes to the highest level of the aneurism, while the circulation in the sac is absolutely controlled by compression of the main artery on the central or cardiac side of the aneurism. With the finger of the operator constantly on the aneurism to make sure that its pulsation is absolutely controlled, the elastic bandage is held in place for five or six minutes in old subjects, and ten in the younger patients (less risk of injury to the arteries, thrombus, embolus, etc.).

The elastic bandage is now quickly removed, while the compressor still secures the main artery. Close attention must now

be given to the returning wave of hyperæmia, and the presence of the blush is noted as it descends rapidly at first to the zone below the level of the compressor, and then gradually, as it spreads down to the leg, ankle, and toes.

The author has applied this test several times and has conclusively proved that the hyperæmic blush after elastic constriction will descend and spread over the entire limb, in spite of the occlusion of the main trunk, *provided the collateral circulation is efficient*. The hyperæmic wave will not descend and spread over the peripheral parts if the collateral circulation is inefficient.

Contrary to the teachings of Moszkowicz, the author is convinced, by his personal observations, that the hyperæmic blush is not arrested on a level with the line of obstruction or obliteration of the main trunk, but will always spread beyond it to the peripheral parts as long as the collaterals are efficient and pervious. The hyperæmic test is a test of the existence of a capillary circulation in the peripheral parts, regardless of the fate of the main trunk.

There are great variations in the time that may be required for the appearance and the spread of the blush over the extreme periphery; but when it does appear, the operator may rest assured of the vitality in all the "pink parts."

The clinical applications of this test, as well as its interpretation as a circulatory phenomenon, were discussed by the author.

In a second division of his address, the speaker discussed the mode of testing the efficiency of the collateral circulation of the brain and in the arterial trunks at the roots of limbs, where no direct compression of the main artery on the cardiac side is possible, and where the hyperæmic test is not available. In these regions, especially in the neck, he advocated the preliminary occlusion of the main artery with removable aluminum bands, which occlude the artery without injuring its walls. If any evidence of peripheral disturbance should occur, either in the brain or peripheral parts, the band could be removed. He had demonstrated by experiments performed on dogs, with the assistance of Dr. Allen, that the bands could be allowed to remain on the vessel fully seventy-two hours without permanent injury; so that within this time the bands could be removed and the circulation restored.

The following are the conclusions arrived at: 1. It is possible to compress a vessel to the point of obliterating the pulse and

maintain this pressure for a period of from three to four days, before adhesive or obliterative changes in the intima occur. 2. All the vessels clamped in this manner stood compression seventy-two hours without apparent microscopic changes in the intima; some few began to show marked changes in ninety-six hours. 3. There is apparently no reason why in occluding the great vessels at the root of the neck, chest, and lower abdomen, in continuity, these removable bands should not be substituted for the circular ligature, which permanently damages the artery, even when carefully applied. Furthermore, the ligature does not permit of the release of the constriction after a few hours or days of observation, without certainty of thrombus formation at the seat of the ligation. 4. In view of the preceding statements, it would seem logical to utilize the simple method of occlusion as a preliminary test of the efficiency of the collateral circulation in all regions in which the hyperæmia test as previously described is not applicable. A brief statement of this research was presented at the meeting of the Society of Clinical Surgery last November at Rochester, Minn. Since then more experimental and clinical work has been done, and a careful histologic study of the specimens removed has also been conducted with the assistance of Dr. Gurd of the Laboratory of Surgical Pathology of Tulane University. It is the intention of the author to submit a joint paper with his assistant, Dr. Allen, at the next meeting of the American Medical Association in St. Louis, in which a full account of the work thus far done will be presented.

DR. WILLIAM S. HALSTED, of Baltimore, reported an operation for a large tumor of the popliteal space which necessitated the excision of practically the entire popliteal artery, vein, and nerve, and in which was used Carrel's method of vessel transplantation. The circulation in the limb was not interfered with at all or very little, and there were no evidences of interference with the general circulation, but this could not be attributed to the transplantation of the vein, which became thrombosed in the lower part. With reference to partial occlusion of arteries in the cure of aneurism, they had had two cases, one in which a subclavian aneurism was practically cured for a year, and one of enormous iliofemoral aneurism in which the band cut off the pulse but did not altogether interrupt the circulation in the artery below. Occlusion of the common iliac artery in from 25 to 33 per cent. results in gangrene of the limb, but so far as he knew

there was no reported case of gangrene from aseptic ligation of the common carotid artery.

DR. CHARLES H. MAYO, of Rochester, Minn., mentioned the case of a patient who came to him after the common carotid on one side had been ligated for arteriovenous aneurism. In this operation an attempt was made to ligate the veins around the orbit, resulting in the loss of the eye. When the patient came to him there was an enormous protrusion of the left eye, and pulsating veins on that side of the head. He determined to occlude the common carotid, which he proceeded to do under cocaine anæsthesia, using a little clip of tin about three-quarters of an inch long and the width of the artery. When almost through with the operation the patient remarked that she could not see anything; he immediately began to loosen the clip until her vision returned. That was done six months ago and last week the clip was still on her common carotid, and her vision was better than before operation.

DR. JOSEPH RANSOHOFF, of Cincinnati, was of opinion that if there is an opportunity for circulation to be thoroughly established there is no danger from the tying of the common carotid.

DR. ALEXANDER PRIMROSE, of Toronto, had found that the tying of the common carotid is safe in most young subjects but dangerous in old people.

DR. MATAS remarked in closing that in his tests he had determined that the artery or vein retains its integrity, and the circulation can be restored if the band is removed within seventy-two hours.

END-TO-END INTESTINAL ANASTOMOSIS BY THE INVAGINATION METHOD.

DR. C. L. GIBSON, of New York, read this paper, for which see page 116.

DR. CHARLES H. MAYO, of Rochester, Minn., said that the invagination method of intestinal anastomosis was valuable in the removal of tumors low in the sigmoid; at the upper rectum, about the only way to get a union is to invaginate the upper end into the lower.

DR. JOHN B. DEAVER, of Philadelphia, reported the following cases in this regard: In the early part of last winter an artificial anus caused by ulcerative separation of the lower sigmoid at junction with rectum, due to pressure necrosis consequent upon

the presence of an old appendiceal abscess evacuated through the linea alba some weeks previously. Spencer Wells forceps passed up rectum, and sigmoid brought down to anus and stitched to freshened margin of anus. Patient made a good recovery. The second case occurred three weeks ago, being one in which the lower sigmoid was damaged in removal, by panhysterectomy, of a uterine tumor involving the bowel. Patient recovered.

POSTOPERATIVE INTESTINAL OBSTRUCTION.

DR. GEORGE WOOLSEY, of New York, read a paper with this title, which, in abstract, is as follows:

Importance of Subject.—Common occurrence by reason of frequency of abdominal operations, in spite of improved technic. Frequency of septic or paralytic cases much reduced by improved technic. Fifty cases collected in past five years in the Presbyterian Hospital, only six of these paralytic obstruction, nine due to strangulation, two to volvulus, and most of the remainder to angulation. Nine of these in his service (mortality 12.5 per cent. in eight operations). An equal number in practice elsewhere.

Classification.—Early and late (Broca), mechanical and dynamic (Mikulicz). Mechanical ileus comprises strangulation and obturation. Dynamic, or better paralytic, obstruction most often due to sepsis, some cases due to postoperative atony, others to disturbance of innervation.

Etiology.—Two great factors, septic and mechanical.

A. Mechanical.—(a) Strangulation usually due to band or volvulus, or both. When blood supply cut off paralysis of gut is added. (b) Obturation commonly depends on angulation. Distended proximal arms of loop presses on distal arm and closes it like a trap, the adhesion of the end of the loop preventing it from being straightened out by peristalsis. Adhesions most often in or near pelvis. Most adhesions disappear in time. Factors determining obstruction by adhesions: (a) adhesions of gut in an abnormal position; (b) idiosyncrasy to the formation of many and firm adhesions. Other causes of mechanical obstruction: (a) secondary abscess, causing pressure and usually a valve-like closure, as in cases of adhesions; (b) Trendelenburg position; (c) pressure of root of mesentery on duodenum, causing arteriomesenteric ileus or acute dilatation of the stomach.

B. Paralytic Obstruction.—A similar result (paralysis) due

to (a) sepsis, the most common cause, (b) handling of intestine causing atony, or (c) to trauma of nerve supply, as in extra-peritoneal operations, etc. Sepsis probably acts mostly by a reflex paralysis on Auerbach's plexus. Peristalsis may be reflexly inhibited through splanchnic nerves (Cannon and Murphy). Overdistention may arise from the atony due to handling or traumatism of nerves or plexus. Overdistention may cause obstruction by causing (a) paralysis, (b) angulation, (c) volvulus.

Obstruction most often follows appendicitis or appendectomy (32 in 50), next most often pelvic conditions (13 in 50), especially ovarian cysts. Mortality of the 50 cases (48 operations), 37.2 per cent.

Pathology of Fatal Result.—Death due to bacteriæmia in septic peritonitis. Where no peritonitis, death attributed to autointoxication (neurin, putrescin, etc.). Braun denies this and claims terminal sinking of blood-pressure due to basal anæmia from great blood stasis in splanchnic area, and that drainage of bowel favors cure by relieving congestion in splanchnic area, not by avoiding autointoxication. Several experiments confirm this.

Diagnosis easy from symptoms in late cases. If morphine has to be repeated for pain, operate for obstruction. In many cases we can distinguish between strangulation and obturation by "peritoneal shock," intensity of onset, and symptoms. In some cases we can locate position of obstruction by position of early pain, distention, exaggerated peristalsis, character and onset of vomiting, Von Wahl's sign, etc.

In *early* cases diagnosis not so easy, obscured by peritonitis, operative trauma, sequelæ of anæsthesia. Where peritonitis was or is present must distinguish between it and obstruction. Many of the symptoms identical. Diagnostic symptoms given. Rigidity the important sign of peritonitis, absolute constipation of obstruction. If latter cannot be relieved, diagnose obstruction. Some early causes of mechanical origin. Important but difficult to distinguish them. Presence or absence of pain, peristalsis, distention, and other signs help to determine question. Possibility of acute dilatation of stomach (symptoms enumerated), and of obstruction with many symptoms lacking must be remembered.

Treatment.—A. Prophylaxis, great importance and success of it. Problem is to prevent sepsis, operative trauma, and adhesions, to which nearly all cases are due. Hence operate all cases

of appendicitis as soon as diagnosis is made. When septic peritonitis present, modern technic (Murphy's) will cure most cases and prevent paralytic ileus. Opposite plan advocated by some, *i.e.*, excitation of peristalsis to distribute germs, increase hyperæmia of peritoneum, and thereby the autolysis and resorption of the pus. Physostigmine or atropine used by some before and after operation. The real field for this is in postoperative atony. To prevent the atony avoid rough and undue handling of intestines. When early distention is marked and increasing, gain early action of bowels by enemata of various kinds, with or without physostigmine. Stupes and lavage also very useful. Careful postoperative treatment of diet, digestion, and bowel movement very essential prophylactically.

Adhesions a prolific source of obstruction. Can we prevent them? Not altogether. It is largely a matter of careful technic. Operate early, rapidly, yet carefully, avoid drainage. If drains necessary, the kind of drains and their position of great importance. Remove source of infection, avoid displacing of bowels, cover denuded peritoneum if possible, encourage early peristalsis and frequent change of position after operation. Can we prevent the reformation of adhesions? No, we may minimize them. Great variety of substance interposes between raw surfaces. No one a panacea. Many enumerated. Mucilage apparently the best.

Treatment of actual obstructions is *operative*.

Late Obstructions.—Ample incision over site of obstruction if known, otherwise exploratory. Operate early. Collapsed and distended coils guide to obstruction. Relieve cause. If gut not viable resect and anastomose.

Early Obstructions.—Palliation by enemata, physostigmine, lavage, etc., should not be persisted in too long. Most cases operated too late. If mechanical cause suspected, laparotomy and relief of cause. If paralytic obstruction, enterostomy with flushing and syphonage. Technic of enterostomy. Objections to enterostomy. It should be done earlier to avoid the present poor results. In the early obstructions prophylaxis has given best results and made them much less frequent.

DR. ALBERT J. OCHSNER, of Chicago, said that if immediately upon the appearance of nausea or gaseous distention gastric lavage be instituted there will be fewer instances of intestinal obstruction, following shortly after operation. As regards intes-

tinal obstruction due to conditions appearing many weeks after operation, his observation has been that he had practically no mortality excepting in those cases coming under treatment after having received cathartics.

DR. ALEXANDER H. FERGUSON, of Chicago, said, in regard to operative obstruction and the prevention of adhesions following operations, that for four years he had used subgallate of bismuth, smearing it over all raw surfaces, with most complete satisfaction.

DR. ARPAD G. GERSTER, of New York, said that if we want to make headway against obstructions caused by adhesions we must first know the cause of the adhesions, and this we do not know at present. Many causes have been exploited, the use of packings, the handling of the intestines, and other mostly traumatic lesions to the peritoneal coat, but we have seen in the presence of the greatest traumatism that could be inflicted on the intestine that adhesions did not form. Here the pathologist and experimental surgeon must come to our aid. He believed that the cause must be looked for in certain conditions of the blood of the patient.

ABNORMAL POSITION OF THE DUODENUM.

DR. G. E. ARMSTRONG, of Montreal, read a paper with this title, for which see page 111.

HEPATICODUODENAL ANASTOMOSIS.

DR. GEORGE E. BREWER, of New York, read a paper with this title, for which see page 830, June, 1910.

RESECTION OF THE PANCREAS.

DR. J. M. T. FINNEY, of Baltimore, read a paper with this title, for which see page 818, June, 1910.

DR. M. L. HARRIS, of Chicago, mentioned the case of a policeman who was shot by a 38 calibre bullet which entered just below the twelfth rib on the left side and was found just beneath the skin a little to the right of the median line between the eighth and ninth ribs. The track of the bullet from before backward was through the right lobe of the liver, the lesser curvature of the stomach, the middle of the pancreas practically bisecting the organ, and the left kidney. The stomach was sewed up, then the pancreas, and as close an approximation of parts made as

possible. Drainage front and back. Fistula resulted but closed in about three months and patient fully recovered.

DR. G. E. ARMSTRONG, of Montreal, with regard to the mobility of pancreatic tumors, mentioned a case in which there was a large pancreatic cyst which for a long time because of its mobility was considered to be a growth in the stomach.

DR. WILLY MEYER, of New York, said that he had had two cases in which the tail of the pancreas was tightly adherent to the existing tumor, and here he put a piece of chromicized gut around it and divided the distal end with the Paquelin cautery. Both patients recovered.

DR. RUDOLPH MATAS, of New Orleans, reported a case of thrombosis of the splenic artery incidentally involving the pancreatic arterial supply, causing degeneration of the organ from the head to the tail, associated with multiple tumor formation in the spleen. The spleen and three-quarters of the pancreas were removed and the patient recovered from the operation, dying about three years later from a slow fever.

VACCINE THERAPY AS AN ADJUNCT TO SURGERY.

DRS. JOHN B. DEAVER, JOHN C. DACOSTA, JR., and D. B. PFEIFFER, of Philadelphia, presented a paper with the above title, an abstract of which is as follows:

There has been established at the German Hospital a special department of Vaccine Therapy. In addition to its well-known and satisfactory use in suppurative affections of the skin and other forms of minor chronic infection, this form of treatment has been used as an adjunct in the treatment of more severe surgical infective conditions.

Vaccines did not prove of service in three cases of streptococcic septicæmia in which the treatment was begun late. Four cases of severe staphylococcic septicæmia recovered, improvement in each case beginning with the initiation of the vaccine treatment. Eight cases of severe septic intoxication without demonstrated bacteræmia were treated by drainage and vaccines. Two were *in extremis* when treatment was begun and died shortly afterwards. The remainder recovered. Five of the cases were streptococcic infections.

Improvement was also noted in a miscellaneous group of cases comprising persistent sinuses, cystitis, thrombosis, etc. Not all cases, however, gave a definite response. The dosage varied

from 25,000,000 to 750,000,000. The sicker the patient and the less satisfactory the response, the smaller and less frequent should be the dose. Streptococcus also was used in smaller dosage than staphylococcus.

On the basis of these results the paper concludes:

Specific vaccine treatment in our hands has not proved of benefit in the later stages of streptococcic septicæmia.

Staphylococcic septicæmia has been treated with most favorable results at all stages.

Septic intoxications without demonstrated blood invasion in a majority of the cases display general and local improvement under the use of vaccines if given early: the later the treatment, the less certain and satisfactory the result.

Localized and persistent suppurating lesions are sometimes markedly benefited by vaccines.

Surgical procedures for the relief of infectious conditions should be reinforced by vaccine treatment, which should be begun as early as is consistent with the case, and preferably by autogenous organisms.

No hospital can be considered fully equipped which is not prepared to supply this form of treatment in conjunction with established measures.

THERAPY BY BACTERINS AND TUBERCULINS IN MIXED SUPPURATIVE BONE AND JOINT DISEASE.

DRS. DEFOREST WILLARD and B. A. THOMAS, of Philadelphia, read a paper with the above title, for which see page 761, June, 1910.

DR. J. M. T. FINNEY, of Baltimore, in regard to the use of vaccines in chronic infections of the bladder from the colon bacillus, mentioned a case in which, after every other method had failed, injections were followed by the most astonishing results, the bladder symptoms all practically disappearing.

DR. WILLIS G. MACDONALD, of Albany, called attention to the extreme importance of not giving too large a dose of vaccines.

SURGEON-GENERAL STERNBERG, of Washington, said that it was impossible to doubt that vaccine treatment is beneficial in a certain class of cases, but it is difficult to understand why it should be. You have a certain specific micro-organism in the blood in large numbers, producing toxic products, and why the

introduction of a comparatively small number of the same micro-organisms under the skin should have such a potent effect in arresting the progress of the disease was to him inexplicable.

DR. L. L. McARTHUR, of Chicago, called attention to the tuberculin treatment in essential hemorrhage of the kidney. Treatment with the autogenous vaccine of the colon bacillus in several such cases has been productive of a cure.

DR. JOHN B. MURPHY, of Chicago, said that the essential hemorrhage of the kidney, the essential hemorrhage of the uterus occurring in girls under twenty with tuberculous histories, respond marvellously to proper dosage with tuberculin. Great assistance is rendered by this treatment in cases of bone tuberculosis. There is, however, no more treacherous and dangerous drug than tuberculin if improperly given. As a stimulant, and as an aid to surgical tuberculosis, he knew of nothing so good when the treatment is carefully administered.

DR. JOSEPH C. BLOODGOOD, of Baltimore, had had no experience in the vaccine treatment but suggested in regard to the essential hemorrhage of the kidney that a more simple serum be tried first. The Professor of Pathology at Tufts College has demonstrated the rapidity with which blood-serum of all animals will check hemorrhage, so perhaps it is some antibody in the serum and not the organism that checks the hemorrhage when tuberculin is used in these cases.

DR. JOSEPH A. BLAKE, of New York, had been employing the vaccine treatment pretty persistently, and in chronic infections had found the autogenous vaccines of great benefit.

DR. ARTHUR DEAN BEVAN, of Chicago, considered it too early at this time to arrive at any definite conclusions with regard to the value of this treatment. He had been particularly interested in the application of the vaccine treatment to tuberculosis of the kidney and mixed infection of tuberculosis of the colon, and although he knew of cases which under good management with this treatment had gone on to recovery, he also knew of cases which without the vaccine treatment also recovered.

DR. FRANCIS B. HARRINGTON, of Boston, said that he had seen some cases in which autogenous vaccines had been of great benefit, and also some cases in which they were productive of great harm.

DR. HARRY M. SHERMAN, of San Francisco, said they were using tuberculin more and more in the Children's Hospital.

With regard to the vaccine treatment, they had had no success with the streptococcus injection.

DR. EMMET RIXFORD, of San Francisco, mentioned a case of tuberculous anal fistula, tuberculosis of the spinal cord, and tuberculosis of the wrist which under treatment with tuberculin was completely restored to health. It has been two years since the treatment, there is now no sign of tuberculosis, and the patient has gained 40 pounds in weight.

THE STUDY OF THE ETIOLOGY OF CANCER BASED ON CLINICAL STATISTICS.

DR. ISAAC LEVIN, of New York, read a paper with the above title, for which see page 768, June, 1910.

THE SIMULATION OF NEOPLASMS BY INFLAMMATORY PROCESSES.

DR. C. A. HAMANN, of Cleveland, Ohio, read a paper with the above title, for which see page 782, June, 1910.

DR. HARRY M. SHERMAN, of San Francisco, reported an instance in which through a mistaken diagnosis he removed an inflammatory mass believing it to be sarcoma including the parotid gland. A radical operation was done, beginning with the clavicle, with removal of all the tissues up to and including the parotid gland, following the report on a section of the growth sent to the pathologist that it was probably of sarcomatous origin. When the whole mass was sent to the laboratory for examination, however, it was proven to be an inflammatory mass in the centre of which was a normal parotid gland. In the light, however, of no clinical symptoms of syphilis and a negative Wassermann, and a definite tumor mass, the evidence against syphilis in the diagnosis was enough to justify the operation for sarcoma.

WANDERING SPLEEN, WITH TWISTED PEDICLE, PRO- DUCING A TUMOR IN THE PELVIS.

DR. A. MACLAREN, of St. Paul, Minn., read a paper with this title, for which see page 834, June, 1910.

DR. RUDOLPH MATAS, of New Orleans, in this connection reported two cases of misplaced spleen, one occurring in his own practice and one in the practice of a colleague. In both cases the spleen was lodged in the pelvis. In his own case there was a certain amount of peritonitis with two twists in the pedicle and beginning gangrene. The spleen filled the whole

pelvis. He removed the organ and the patient made a good recovery.

RESECTIONS OF THE RECTUM FOR CANCER.

DR. WILLIAM J. MAYO, of Rochester, Minn., read a paper with this title, for which see page 854, June, 1910.

DR. ARTHUR DEAN BEVAN, of Chicago, emphasized a point of technic based upon an experience with some twenty cases in which the Kraske operation was performed. That is, during the Kraske operation he did not employ a single ligature, but simply as he comes to the tissues on the sides of the incision freeing the rectum, massive 10 inch or 12 inch clamps are put on the tissues, for instance, high up on the levator ani muscles and on the inferior hemorrhoidal vessels which supply the rectum and the lower part of the sigmoid. With the employment of these clamps there is less risk of hemorrhage and a greater saving of time than if an attempt is made at ligation.

DR. JOSEPH C. BLOODGOOD, of Baltimore, said that in one of his first cases, operated on about six years ago, he was able to save three inches of the anus and rectum, making a suture with the sigmoid which was brought down, and this patient has not only been as well as before, but has perfect function.

DR. ALEXANDER H. FERGUSON, of Chicago, said that in some of his cases he had resorted to the combined operation in two stages to advantage. Open the abdomen, take the proximal end of the bowel, make an artificial anus, invert the distal end into the rectum—that would be one operation; then, when the patient is in good condition, remove the rectum from below, the bowel being already inverted giving ready access to the mass. By the use of clamps without ligatures the operation can be done in a few minutes.

DR. JOSEPH A. BLAKE, of New York, said that he had had more experience with the combined operation than with any other; he had done twelve consecutive operations in that way without any mortality. The mortality is less if a permanent colostomy is done; it avoids infection and the operative field is kept comparatively clean, and it also affords the opportunity of removing the whole growth at the lower part of the bowel. This procedure should be confined to those cases at the middle of the rectum or above, and those in which the anal sphincter is involved and has to be removed.

DR. G. E. ARMSTRONG, of Montreal, said that in the low cases where the sphincter has been involved he had sometimes succeeded in getting a satisfactory sphincter by bringing the upper ends down through the lower fibres of the gluteus maximus. One such case operated upon ten years ago now has perfect control.

DR. WILLIAM J. MAYO, of Rochester, Minn., in closing said that they had had some very satisfactory cases of union between the sigmoid and lower portion of the rectum, and the rule has been, when made from above it has been all right, but when made through the posterior incision, or through the vagina, there is ulcer and fistula. In regard to permanent colostomy, he had often regretted not having employed this procedure, because some of the deaths had been due to infection.

He emphasized the point that it is practically impossible to make honest percentages of cases such as these, for the reason that if all cases which cannot be traced are counted as dead the mortality rate would mount up. This is the only way, however, to consider the cases of which there is no absolute record, and proves the inaccuracy of any percentages which one may try to strike.

PROGNOSIS AND OPERATIVE TREATMENT OF FRACTURE OF THE BASE OF THE SKULL.

DR. JOSEPH RANSOHOFF, of Cincinnati, Ohio, read a paper with this title, for which see page 796, June, 1910.

DR. FRANK E. BUNTS, of Cleveland, said that in an ordinary case of fracture of the base of the skull in which the blood-pressure can be obtained, a beginning choked disc and œdema, and hemorrhage in the brain detected, the decompression operation should be performed, and in many such cases we may expect altogether beneficial results.

DR. JOSEPH C. BLOODGOOD, of Baltimore, said that up to the present time he had been unable to find any case of epilepsy following an injury to the skull in which some piece of the skull was removed, either by operation or by the injury itself. This would rather substantiate the view that epilepsy is more apt to be started up by changes in pressure than by actual injury.

DR. G. E. ARMSTRONG, of Montreal, said that if in these cases the pressure is subtentorial, as indicated by the respiration, aspiration of the cerebrospinal canal may prove very injurious.

Apropos to Dr. Bloodgood's remark, he knew two instances where epilepsy had followed in the presence of considerable defect in the skull; one following the kick of a horse in a young man, where there was rupture of membrane, loss of brain tissue with considerable defect in the skull remaining, and epilepsy beginning a couple of years later; the other, in a man injured in the frontal region in which there is a considerable defect in the skull, and epilepsy has followed.

A METHOD OF OVERCOMING THE SHORTENING IN OLD FRACTURES TREATED BY THE OPEN METHOD.

DR. EDWARD MARTIN, of Philadelphia, said that the major difficulty in the treatment of ununited fractures of the long bones, or those which have united with shortening so great as to be crippling, is incident to the difficulty in overcoming the shortening rather than to that of providing means for securing retention after this deformity has been once overcome; pegs, screws, plates, and lashings, supplemented by proper splinting, usually proving adequate for this latter end. A shortening which has lasted even for some weeks in, for instance, the femur, is so little influenced by practically any amount of traction that can be applied to the foot or leg that resection is often needful before the ends of the bone can be brought in proper relation to each other. This traction when applied by the hands of powerful assistants is intermittent and inefficient. When applied by the compound pulley it is vulnerating and likely to injure parts remote from the seat of injury. Moreover, when confined within safe limits, it is too often entirely inadequate. It was because of the complete futility of any method of traction which could be applied to the leg and foot in the case of an ununited fracture of the femur with $2\frac{1}{2}$ inches of shortening that the present method of overcoming the shortening was devised. It consists in a long strong canvas strip, pocketed in the middle and looped at the ends. The bones at the seat of fracture are freed, the pocket is slipped over the proximal end of the distal fragment, the ends of the canvas strip are carried in the long axis of the limb, and in the loops is fixed a cord to which are attached the weights. By thumb pressure the bone is kept from angling out of the wound, and weights up to 100 pounds, or even more, are attached to the rope. In from three to five minutes the shortening is overcome. Only those structures which interfere with proper

placement are stretched, and this is done so thoroughly that there is but slight tendency to the reproduction of deformity.

DR. RICHARD H. HARTE, of Philadelphia, said that in regard to extension he considered a pulley similar to that used on boats, a double and single pulley, to be the best type to use. These should not be close together, but enough line between them to allow of manipulation of the limb by the operator. After a thorough incision has been made and the ends of the bone exposed, one can disengage the bands of tissue by the employment of steel elevators. It is important to do as little damage as possible to the tissues. He did not consider silver plates strong enough to hold the bones in position and therefore would always advise the use of a heavy steel plate such as that suggested by Lane.

DR. ALBERT J. OCHSNER, of Chicago, described a method which consisted in the slow stretching of the muscles instead of the rapid stretching; the only thing that is peculiar about the method is the application of rubber adhesive strips to as high a point above the seat of fracture as is possible. For instance, instead of applying the rubber adhesive up to the fracture, it should be applied over the entire length of the thigh, then, with no more than 24 pounds of weight, he had, in every fracture where there had not been a union, been able to stretch the muscles sufficiently to replace the fractured ends without making a resection of them. In cases where there is a union in malposition, the muscles will stretch to a marked extent. It is important to use two Lane plates, with two screws at each end in order to keep the bones from slipping.

DR. JAMES E. THOMPSON, of Galveston, thought the important point to be that it is not the contraction of the muscles which prevents reduction; it is hemorrhage, and after this blood-clot has been evacuated the bones can be held in proper position.

DR. HARRY M. SHERMAN, of San Francisco, did not consider the method of extension described by Dr. Harte as good as where two hanks of yarn are applied as perineal straps, the weight coming on the tuberosity of the ischium. On the foot is put another hank of yarn. The pulling upon the bones has been measured, and over 200 pounds of weight have been applied in some cases without injury to the ligaments of the ankle or knee, and that is sufficient to pull out any tissue interfering with the approximation of the bones.

DR. EDWARD MARTIN, of Philadelphia, in closing said that

the length of the screws used in adjusting these plates should be the thickness of the bone; they should be threaded up to their heads, and to hold the plate in place it is required that they penetrate entirely through the bone and no more.

In cases of extension he preferred to use the old-fashioned resin plaster, properly made, because the rubber plaster always excoriates the skin.

FRACTURE DISLOCATIONS OF THE OS INNOMINATUM.

DR. HARRY M. SHERMAN, of San Francisco, Cal., read a paper with this title in which he made the point that simple uncomplicated fracture of the pelvic bones was not of necessity a serious lesion, but that healing could be expected in an ordinary way as after a fracture of a bone of an extremity; that the really serious lesion was the complication of injuries to the bladder, the intestines, or the vascular system; that injuries to the bladder were more likely to occur when the fracture had been due to anteroposterior compressive force; that injuries to the urethra were more apt to occur when the fracture was due to transverse compressive force; that the present indications were to open at once the space of Retzius and make a reverse catheterization and perineal section with lateral incisions in the groin and perineum for drainage of all areolar planes. With this technic the mortality should be reduced to about 33 per cent. as against 60 per cent.

DR. ARPAD G. GERSTER, of New York, said that he had had in his experience a case of fracture of the female pelvis on the left side in which there was no injury of the urethra, although it was compressed to such an extent by a solid blood-clot that retention followed and had to be relieved for fifteen or sixteen days by the use of the catheter. The woman recovered, there was no other injury present. Another case was one in which there was fatal hemorrhage following fracture of the pelvis. Post-mortem revealed extensive laceration of one of the common iliac arteries and subperitoneal hemorrhage.

MOMBURG'S METHOD OF ARTIFICIAL ANÆMIA BY SUPRAPELVIC CONSTRICTION.

DR. ARPAD G. GERSTER, of New York, read a paper with the above title, for which see page 878, June, 1910.

DR. JOSEPH RANSOHOFF, of Cincinnati, had seen this method

pursued in one case, and in this no ill effects resulted from its employment.

DR. HARRY M. SHERMAN, of San Francisco, suggested that where this method is used there is the same vasomotor paralysis below the point of constriction as after the employment of the ordinary Esmarch bandage on the extremities, and that this may be a reason for returning the vessels to the circulation gradually, otherwise there might be hemorrhage into the arteries.

DR. RUDOLPH MATAS, of New Orleans, had pursued some experiments among some students with this method, but found that a fair test of it could not be made unless the patient was anæsthetized in order to gain complete relaxation. From his very imperfect experiments, however, it was shown that in all weak hearts one is liable to have prompt failure; instead of noting the usual increase in blood-pressure, there will be a fall, and this indicates an inability on the part of the heart to keep up. He would not advise the use of the Momburg constrictor in any patients suspected of having any cardiac irregularity, but believed it will prove of great benefit in producing artificial anæmia in strong, robust individuals without being followed by any ill effects.

DR. ARPAD G. GERSTER, of New York, in closing specially emphasized the point that this constrictor is not indicated in cases in which there is any disturbance with the cardiac function. It has proven particularly valuable in postpartum hemorrhage in healthy individuals.

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ORIGINAL MEMOIRS.

BENIGN BONE CYSTS, OSTITIS FIBROSA, GIANT-CELL SARCOMA AND BONE ANEURISM OF THE LONG PIPE BONES.*

A CLINICAL AND PATHOLOGICAL STUDY WITH THE CONCLUSION THAT CONSERVATIVE TREATMENT IS JUSTIFIABLE.

BY JOSEPH C. BLOODGOOD, M.D.,

OF BALTIMORE,

Associate Professor of Surgery in Johns Hopkins University.

IN many surgical lesions technic is ahead of diagnosis.

The development of technic is more rapid, because the results of faulty technic are immediate, while the development of diagnosis is more difficult, especially in tumors, because the results are more remote.

Treatment of tumors which will insure the patient the greatest possibility of a permanent cure with the least mutilation will only be accomplished when surgeons have a better conception of the local growth of neoplasms, both benign and malignant, and are able to diagnose with differentiation the various lesions at the exploratory incision, with, or better without, the aid of a rapidly frozen section.

This is especially true of bone lesions, and I propose to discuss here the three mentioned in the title of this paper.

* Read before the American Surgical Association, May 3, 1910.

BENIGN BONE CYSTS AND OTITIS FIBROSA.

In the literature (and including my own collection) up to April, 1910, I have studied 89 cases which are classified as bone cysts. These may be divided into two large groups: (A) the true bone cysts, which have a definite relation to otitis fibrosa, and (B) cysts in the medullary cavity due to other conditions.

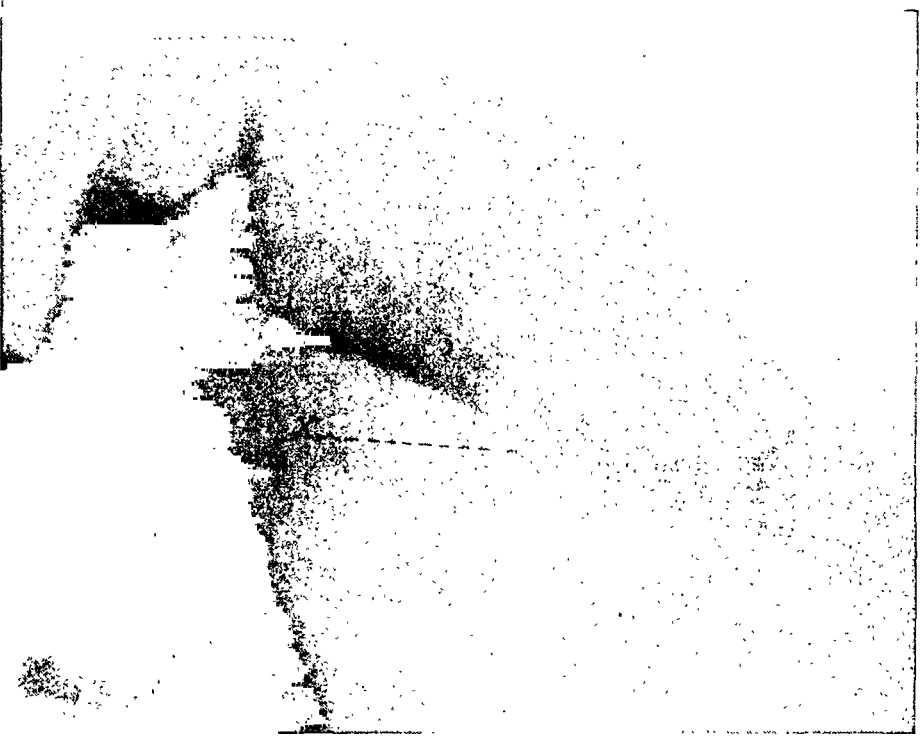
Of the first group (A) there are 69 cases, and they may be divided in the following six varieties:

1. Medullary cysts (16 cases), in which the bony shell has no definite connective-tissue lining (Figs. 1 and 2). Here, in the gross, there is nothing but the fluid contents and the bone shell, but microscopically one is always able to find between the bone lamellæ of the bone shell a new connective tissue—microscopically otitis fibrosa. Two of the cases upon which I operated belong to this type, and I am quite positive as to the practical absence of a definite connective-tissue lining.

2. In this variety (22 cases) there is a definite connective-tissue lining which can be peeled from the bony shell (Fig. 3). Microscopically, it is identical with the fibrous tissue between the bone lamellæ in the bone shell of the first variety. Two cases, sent to me by Dr. Eisendrath of Chicago, and one, sent to my laboratory by my colleague, Dr. Baer, belong here. So that I am quite convinced of the presence of this definite connective-tissue lining which I have seen in the gross and examined microscopically. The case operated on by Dr. Sowers of Washington (Fig. 4) (the tissue of which he brought to me for examination) is an example of one in which the connective-tissue lining was thickest—5 to 8 mm. It is usually 1 to 2 mm.

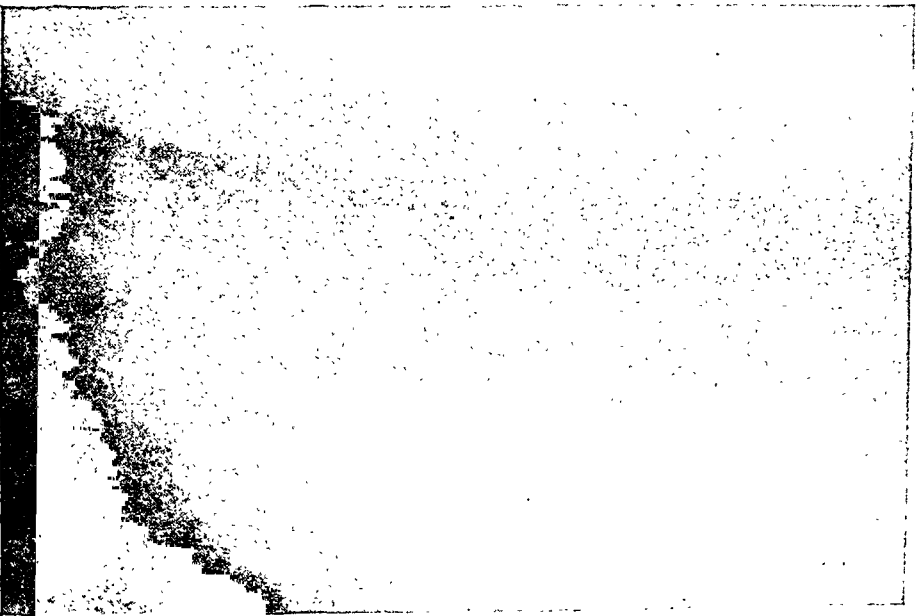
3. In this smaller group of cases (6 cases) the cyst in the medullary cavity is a small affair. It may be single or multiple, usually the former. The medullary cavity is filled with the same fibrous tissue which formed the connective-tissue membrane of the second group. I have had the opportunity to see an example in the tissue removed from the femur by Dr. Halsted (Figs. 5 and 6).

FIG. 1.



Pathol. No. 4993. Bone cyst of humerus; no connective-tissue lining. White female aged seven years; history of fracture one year ago with healing; recent fracture four days, pain and loss of function; 1903 curetting (Bloodgood); 1910 well. See Fig. 2. X, fracture.

FIG. 2.



Pathol. No. 4993. X-ray seven years after operation in case illustrated in Fig. 1.

FIG. 3.



Pathol. No. 9155. Bone cyst of humerus. White male aged thirteen years. Expansion of humerus after injury (fracture) two years ago; this slowly increased. Recent injury five days; no evidence of fracture. Curetting by Dr. Eisendrath of Chicago. Definite connective-tissue wall. Well nine months since operation. As compared with Fig. 1 the cyst does not extend to the upper epiphysis; there is evidence of an old healed fracture at X.

Pathol. No. 10474. Bone cyst of humerus with thick connective-tissue lining. White male aged eighteen years; pain three weeks fracture after a slight trauma three days. Note the extensive involvement with but a slight degree of expansion in contrast of an X-ray of a giant-cell sarcoma or a more malignant medullary sarcoma. The bone capsule is destroyed in some places (X). Curetting by Dr. Sowers of Washington. Recent case. For microscopic pictures see Figs. 22 and 23.

FIG. 5



Pathol. No. 5358. Ostitis fibrosa of the upper half of the femur with a small bone cyst. White boy aged seven years; fracture four and one-half years; limp since; recent expansion of the upper portion of the femur; loss of function ten days since slight trauma. The X-ray shows the slight expansion of the femur, but the central shadow is more opaque than in Figs. 1, 3, and 4. Operation March, 1904, by Dr. Halsted: subperiosteal resection of upper half of femur. See Fig. 6.

4. In this variety (7 cases) there are no cysts. The distended shell of bone is filled with fibrous tissue. I had the opportunity to personally study an example through the courtesy of Dr. Kammerer of New York, who was good enough to send me not only his X-rays (Fig. 7), but also the tissues (Fig. 8) he removed by curetting.

5. In this variety (5 cases) the pathologic picture is somewhat different: there is neither a single cyst, nor a solid mass of fibrous tissue, but the distended shell of bone is partitioned into multiple cavities which either contain fluid (cysts) or fibrous tissue (ostitis fibrosa). Here I have also had occasion to investigate carefully one case, operated on by Dr. Follis in Prof. Halsted's clinic (Figs. 9, 10, 11, and 12).

6. Here I have collected some miscellaneous cases. In one operated upon by Dr. Finney, the cyst in the lower end of the humerus had become infected and had broken through the shell of bone involving the elbow-joint. There are five cases in which there were X-ray studies only. The X-ray of one of these was sent to me by Dr. Colvin of St. Paul (Fig. 13). In three cases I have specimens or photographs of specimens: one sent me by Dr. Roswell Park of Buffalo (Fig. 14), one from Lebert's Atlas (Fig. 15), and one, a specimen given me by Dr. Cotton of Baltimore (Fig. 16). These are single cysts of unusually large size which differ from the majority of the other cases by the abruptness of the bone expansion and the thickness of the bone shell (Figs. 14, 15, 16, and 17). The clinical history of Dr. Cotton's case I have in detail. Two cases are examples of healed bone cysts (Fig. 18), in which the cavity is filled with normal cancellous bone: one of these is an observation of my own. The last cyst I have placed in a group by itself, because it represents the only one, as far as I could make out, in which the patient suffered from any general disease which might be looked upon as an etiological factor. This is a cyst reported by Fraenkel in 1904 in which the patient suffered from scurvy of the infantile type.

We may, therefore, summarize the varieties of Group A as follows:

1. Single cyst, bony shell, no connective-tissue lining, 16 cases.
2. Cyst with a definite connective-tissue lining varying as a rule from 1 to 2 mm.; in Sowers's case 8 mm., 22 cases.
3. A small cyst or cysts in a solid mass of *ostitis fibrosa*, 6 cases.
4. No cysts, but the bone shell is filled with a solid mass of *ostitis fibrosa*, 7 cases.
5. Multilocular cysts, 6 cases.
6. Miscellaneous: (*a*) infected, 1 case; (*b*) X-ray studies only, 5 cases; (*c*) autopsy specimens, 3 cases; (*d*) healed bone cysts, 2 cases; (*e*) cysts in infantile scurvy, 1 case.

These cases have in common the presence of an inflammatory tissue in the medullary cavity (*ostitis fibrosa*), which, with or without cyst formation, is replacing the marrow and cancellous bone producing absorption of the outer table and associated with more or less distention of the thin bone shell. Unless there has been a pathologic fracture, or the cysts are of huge size and long duration, the periosteum is normal and there is little or no new bone formation.

In a few of these cases here and there islands of *cartilage* (Fig. 19) are found. This is more often seen when the cyst is adjacent to the epiphyseal cartilage, but cartilage is never present in sufficient quantity to justify the conclusion that the cyst is due to the liquefaction of a primary or original solid area of cartilage.

In all the cases which I have studied personally, and as far as I can ascertain from reading the literature, the fluid contents of the cyst is never distinctly hemorrhagic; it is usually thin, dark-brown in color, and contains under the microscope blood pigment and blood-cells. When opened the fluid is never under great tension; there may be a few blood coagula floating in the fluid, but this is not a prominent feature; sticking to the bone shell of the first variety, or the connective-tissue membrane of the second, there may be red, blood-stained masses which under the microscope show organized blood-clot and *ostitis fibrosa*.

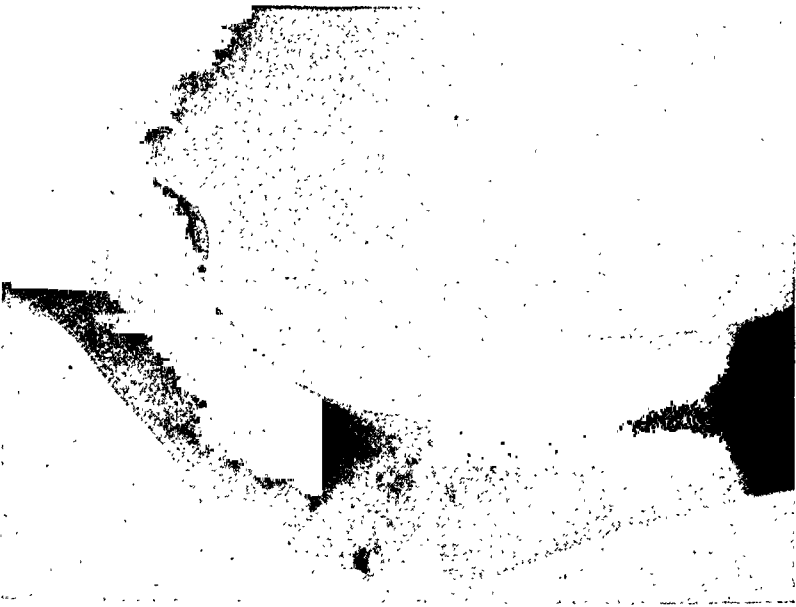
Giant cells have been found in a few cases in this organized

FIG. 6.



Pathol. No. 5358. The specimen removed in the case illustrated in Fig. 5. *Cg.* cartilage near epiphysis; *O.f.*, osteitis fibrosa; *Cy.*, cyst. The bone shell is everywhere preserved. April, 1910, six years well. Complete restoration of femur from periosteum.

FIG. 7.



Pathol. No. 5699. Ostitis fibrosa of femur, no cysts. White male under twenty years of age; fracture some years ago; for five months since heavy lifting pain, limp, angular deformity. The X-ray shows a shadow similar to Fig. 5, and a pathologic fracture. The solid fibrous tissue filling the marrow cavity of the femur was removed with the curette by Dr. Kammerer of New York in November, 1903. 1910—six and one-half years well. See Fig. 8.

FIG. 8.



Pathol. No. 5699. Specimen removed by Dr. Kammerer from case illustrated in Fig. 7. This is the gross appearance of ostitis fibrosa. Compare with Fig. 6.

FIG 9.



Pathol No. 5533. Photograph of patient four years after onset of swelling when first admitted to the clinic and when she refused amputation For condition six years later see Fig. 9a.

FIG 9a



Pathol No 5533 Huge multilocular cyst of lower end of femur Photograph of patient ten years after onset of swelling. Colored female aged thirty-two years at onset of disease. Operation, June, 1904. Partial excision and curetting, death from hemorrhage. See Figs 9, 10, and 11.

FIG. 10



Pathol. No. 5533. The X-ray of the patient illustrated in Fig. 9.

blood-clot (Fig. 20), but more often they are found near the lamellæ of the bone shell (Fig. 21); these giant-cell areas, except in one or two cases, have never been present in sufficient numbers to characterize the picture as a giant-cell sarcoma. In a few cases (none of which I have observed personally) the reporter has looked upon the giant cells as an indication of tumor formation. But in these cases the same perfect healing has followed mere curetting.

I mention here prominently in the introduction the character of the fluid, the peculiar connective tissue within the bone shell, and the normal periosteum, because it is these factors which of themselves alone allow one to make a positive diagnosis at the exploratory incision and to limit the operation to simple curetting.

Suggestive, it must be admitted, is the clinical history and X-ray picture, but in spite of this the differential diagnosis excluding the medullary giant-cell sarcoma, or the other, more malignant medullary tumors, has been, and must be, made at the exploratory incision.

The microscopic histology (Fig. 22) of *ostitis fibrosa* is sufficiently clear to differentiate it from sarcoma. The presence of cartilage (Fig. 19) which is not often found, except when many sections are made, can be looked upon as further evidence of the benignity of the lesion. The presence of giant cells (Figs. 20 and 21) is interesting, but should not confuse the investigator and should not be interpreted as giant-cell sarcoma.

These gross and microscopic characteristics of the benign bone cyst and *ostitis fibrosa* differentiate them from the second group of cysts, from giant-cell sarcoma, and from bone aneurisms. Before proceeding with the detailed study of the benign bone cyst and *ostitis fibrosa*, it seems better to consider the second group of bone cysts.

Group B.—Cyst due to conditions other than *ostitis fibrosa*. Of Group A there are 69 cases, of Group B 20 cases, which are divided into the following six varieties:

7. Cysts in cartilage tumors or enchondromas, 4 cases.
8. Pure myxomas with or without cysts, 5 cases.

9. Cysts in giant-cell sarcoma, 4 cases.
10. Cysts in arthritis deformans or ostitis deformans, 4 cases.
11. Cysts due to a subperiosteal hæmatoma with a bony wall due to ossifying periostitis, 2 cases.
12. Callus cysts, 1 case.

As compared with 69 true bone cysts I find, therefore, in the literature at least 20 cases of benign lesions which in the X-ray resemble somewhat the bone cyst, but which differ at the exploratory incision. They, however, must be considered in the differential diagnosis, and here we meet with no particular difficulties.

The enchondromas of Group 7 are chiefly of historical interest. True central enchondromas of the long pipe bones must indeed be rare lesions, because in spite of the repeated attempts to prove Virchow's view, we find in the literature to-day—thirty-four years after Virchow's publication—but four cases. Virchow at an autopsy in 1876, upon a woman aged 56, found a small cyst in the upper end of the humerus; there had been no clinical symptoms and there was no expansion of bone. He describes fibrocartilage and fibrous connective tissue in the wall of the cyst. Zeroni in 1903 confirmed Virchow's observation. The case is mentioned by Koenig, but I cannot get the original. Fleischhauer in 1905 found in the crest of the ilium of a girl aged 20 a multilocular cyst with clear fluid and cartilage in the wall. Riedel in 1906 reports two cases—an island of cartilage in the tibia and one in the lower end of the femur. The majority of recent publications on bone cysts regard these four cases as accidental findings, and conclude that they have no relation whatever to the true bone cysts.

Group 8.—Pure myxoma without cysts: This is an interesting group. In all the five cases the tumor occupied the medullary cavity of the phalanx. Baer's case I have examined histologically, and it was cured by curetting. Dreesman, as also Blake, curetted, Codman resected, Boström amputated. The curetted patients have remained well. This operation should be looked upon as sufficient. The X-ray does not differ

from a cyst, but so far cysts have been seen in the phalanx only in those cases in which multiple cysts have been present in other bones. The age of onset of these medullary benign myxomas of the phalanges has varied from three to thirty-nine years, the duration of the tumor from one to eighteen (Blake's case) years. Pure myxomas are rare bone tumors. I have observed one exhibiting itself as an exostosis of the shaft of the humerus, another in the medullary cavity of the upper end of the humerus; I have seen it combined with cartilage as a multiple lesion arising from the rib, and as a periosteal growth from the os calcis. I shall discuss these pure myxomas in a second contribution on bone tumors.

Group 9.—Cysts in giant-cell sarcoma: In my personally observed 19 cases of giant-cell sarcoma I have seen cysts in but two. In the contributions on bone cysts, four cases are mentioned as cysts in giant-cell sarcoma. In all of them, except Tietze's case, the data are somewhat incomplete. Chiari in 1878 has reported a giant-cell sarcoma in the sacrum with cyst formation. Koenig observed two cysts in the medullary cavity of a clavicle in young girls, Koerte in the upper end of the femur; this case was cured by curetting. Tietze's tumor was situated in the fibula; the patient was 35, and the tumor had been present one year; it was about the size of a cherry; the symptoms were pain and swelling; the bone was resected; the result is not given.

Without further details it is difficult to know where to place these tumors. I am inclined to view them as very small giant-cell sarcomas. It is interesting that in one case in which the ultimate result is known, the patient has remained well. These tumors might be difficult to distinguish from bone aneurisms.

Group 10.—Cysts in arthritis deformans and ostitis deformans: I have observed one case and find three in the literature.

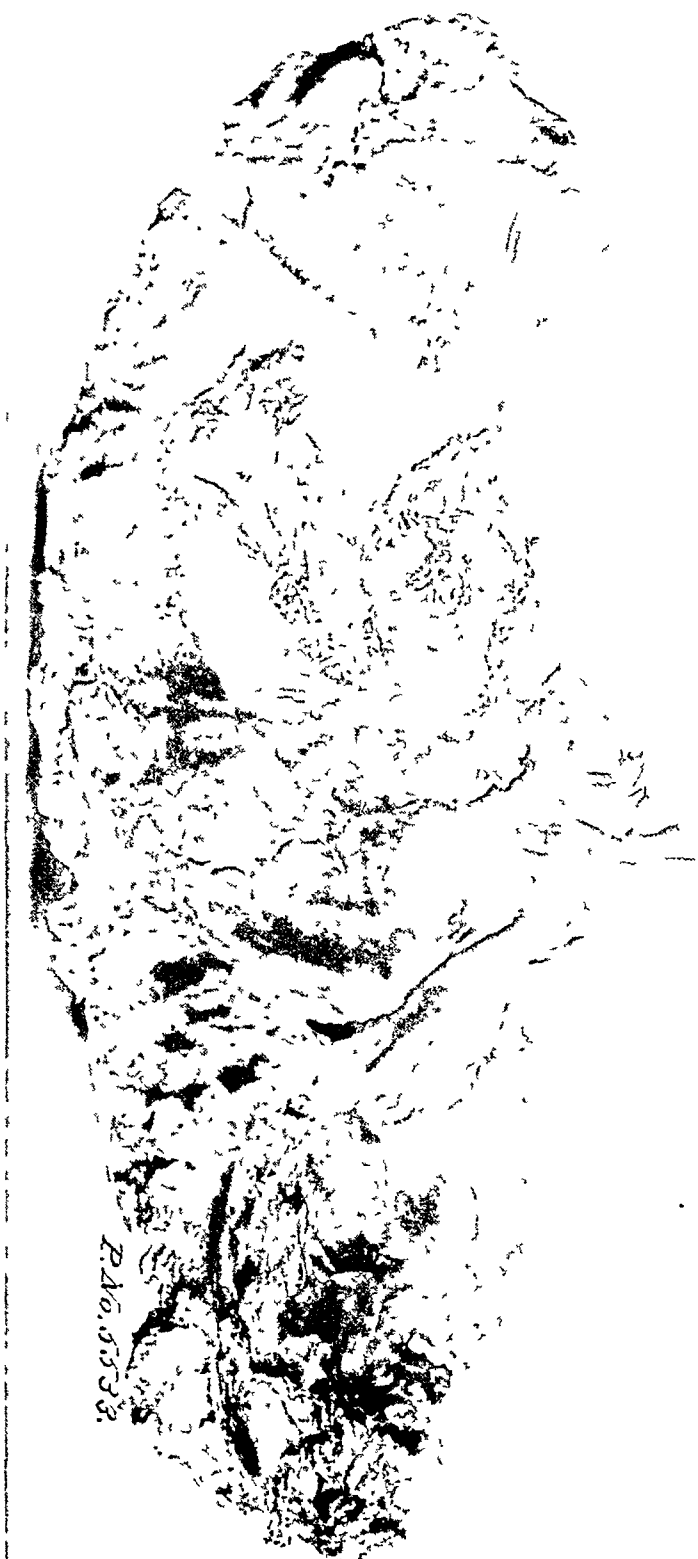
It is interesting to note that all of the patients are over 50. In the one which I studied (Pathol. No. 5807), the cyst was confined to the great trochanter of the femur; the patient was 70; there had been pain, tenderness, and swelling of the trochanter two years after a trauma. The shadow of the cyst

in the X-ray was distinctly irregular. At operation it resembled a large marrow cavity; there was no connective-tissue lining, but the surrounding bone showed both sclerosis and lipomasia. Braun found a cyst in the neck of the femur in a decrepit female aged 78 who two years previously had a fracture of the neck of the femur; the cyst contained a reddish fluid and fat drops. Microscopically, the bone showed osteoporosis and osteoclast giant cells. Schmieden's cyst was situated in the lower end of the femur in a female aged 58 whose knee was resected for arthritis deformans. The details of Ziegler's case I was unable to obtain.

These cysts will never be confused with the simple cysts in younger individuals. If there is but one lesion, as in my case, a tumor would have to be considered. The diagnosis can easily be made at the exploratory incision.

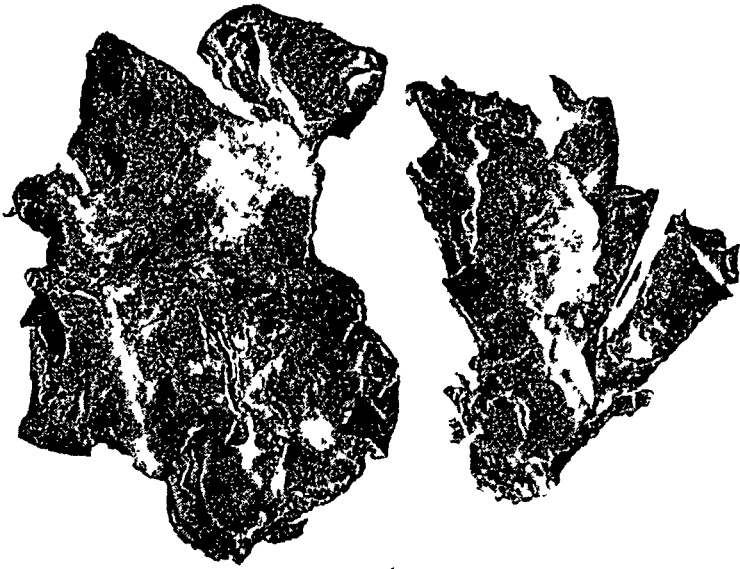
Group II.—Cysts due to periosteal hæmatoma with an osseous wall, two cases: Deetz observed in a male, aged 18, three months after a trauma to the hip a tumor the size of a child's head. At the exploratory operation there was a large cavity filled with coagulated blood; it had a definite bone wall due to ossification of the periosteum. As the patient died six months later of heart disease, Deetz was able to obtain at autopsy the specimen which he illustrated. Glimm observed in a male, aged 25, a similar condition; there was a history of trauma to the right tibia, eighteen months before; the trauma must have been a considerable one, because the patient was confined to bed three weeks, and the swelling never disappeared. At the exploratory operation there was a periosteal bone shell of 3 mm. thickness, and a cavity filled with blood. These two cases are of interest in studying the differential diagnosis of periosteal formations. Ossifying periostitis may follow trauma and is very frequent in syphilis. There is also an ossifying periosteal sarcoma which is relatively benign. The more malignant periosteal sarcomas may be associated with bone formation. I have had a recent observation of this kind. So far I have been able to note only these two cases of Deetz and Glimm in which cyst formation due to hæmatoma has been present in the traumatic ossifying periostitis, and I

FIG. 11.



Pathol No. 5533. The specimen obtained at autopsy in case illustrated in Figs. 9 and 10. This shows the thick outer bone wall and one of the larger septa which is ossified only a few millimetres near the bone shell. See Fig. 12.

FIG. 12.



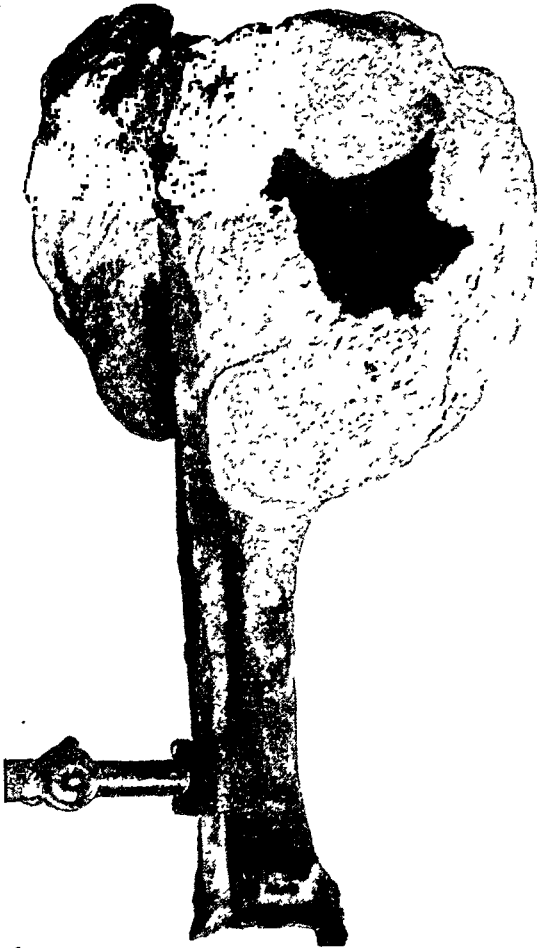
Pathol. No. 5533. Thin partitions separating the cysts in case illustrated in Figs. 9, 10, and 11. This tissue resembles *ostitis fibrosa*. It varies in thickness from 3 mm. to that of transparent parchment paper; areas of cartilage were not found, but there are a few giant-cell areas which can be seen in the gross as darker, somewhat pigmented areas.

FIG. 13.



Pathol. No. 9025. Bone cyst of upper end of ulna. Girl aged six years; swelling seven months. First X-ray by Dr. Colvin of St. Paul in December, 1904. This X-ray was taken April, 1906, one year and three months later; there has been very little change during this time. In March, 1909, four and one-half years, Dr. Colvin informs me that the cavity of the cyst is filling with bone trabeculae; the expansion is still present.

FIG. 14.



Pathol No. 6021. Specimen sent me by Dr. Roswell Park of Buffalo. Abrupt expansion and thick wall of this cyst resemble the condition illustrated in Figs. 15 and 16.

shall have to leave to another paper the consideration of this group of cases. The benign bone cyst is never a periosteal lesion.

Group 12.—Callus cysts of bone: Frangenheim observed a very interesting cyst in an old fracture of the neck of the femur. Apparently it was due to an attempt at marrow formation in callus. From the clinical picture and the X-ray, there should be no difficulty in recognizing the lesion which he pictures.

CLINICAL PICTURE OF BENIGN BONE CYSTS AND OSTITIS FIBROSA.

Age of Onset.—The bone cyst and osteitis fibrosa is distinctly, as Von Mikulicz observed at the German Surgical Congress of 1904, a disease of the youthful individual. Among my 69 cases there are but five in which the age of onset was over 20 years. These five cases are worthy of a more detailed study, because this reduces the actual number of cases in which the patients were older than 20 when the disease was first noted. Bostroem's case was reported in 1883. I have placed this case in my fifth variety, because it was a multilocular cyst; it had an unusual position,—the sacrum,—and was found at autopsy; the age of the female patient is given as 25, but as there is no note as to the duration of the tumor, the onset of the lesion may have been before 20. Pfeiffer's patient was 21 when the first symptom appeared, and it is quite possible from the nature of the case that it had been present longer. Simmons's patient was 28. One of my personally observed patients was 33; here we had a multilocular cyst of the lower end of the femur. Koenig's patient was 40; she was admitted with a recent fracture of the neck of the femur, and the osteitis fibrosa present in the upper ends of both femora was found at the autopsy.

I emphasize the fact that this disease, with the rarest exception, begins before 20, that is, before complete ossification of the epiphyses. Mueller, in tabulating 42 cases, notes 15 between the ages of 20 and 59. I am inclined to think that he

has included in this table cysts due to other causes, or he has not subtracted from the age of the patient at the time of observation the duration of the disease. My investigation, therefore, thoroughly agrees with that of Von Mikulicz as to the youthful age of the patients at the onset of the disease. The youngest patient was $2\frac{1}{2}$; up to 10 years of age there are about 21 cases; between 10 and 15 about 15 cases; between 15 and 20, 11 cases. The age of onset, therefore, in the majority of cases is under 15.

In my personally studied cases of all bone lesions I find that in patients under 10 years of age there are five examples of exostoses, one of medullary giant-cell sarcoma, and two of periosteal spindle- and round-cell sarcoma. Of course, any conclusions based upon the statistics of one clinic are insufficient, but it is interesting to note that in individuals under 10 years of age the medullary lesions are either benign bone cysts with osteitis fibrosa, or the not very malignant giant-cell sarcoma. However, even in my small group between the ages of 10 and 20, I find every variety of malignant medullary tumor, so that between these ages the age of onset is no help in the differential diagnosis.

Duration of the Tumor.—In the study of my personally observed cases of sarcoma, I find a very interesting observation, that is, in the more malignant forms of sarcoma of bone, both periosteal and medullary, not a single case has come under observation after the tumor had been present two years. This is due to the fact that the pain and swelling of the more rapidly growing malignant tumor forces the patient to seek advice early, and, second, because the disease usually causes death by metastasis within two years, while with the benign bone cysts and osteitis fibrosa, pain is rarely a prominent symptom and swelling, as a rule, is a late symptom; the patient generally seeks advice because of the disability of a pathologic fracture. In the early cases, the pathologic fracture may have been the first symptom, and it is quite possible that the disease had been present a longer time. When one studies the X-ray of these cases and views the size of the cavity, it is

difficult to imagine that it is a lesion of less than one or two years' duration. For example, in one of my cases referred to me by Dr. Leary of Boston (Fig. 19), the child was perfectly healthy and the cyst was only found at the routine examination made for fracture. If we assumed this cyst to have begun at the time of the fracture, it would have been of but five days' duration. The only factor in the clinical history which allowed any deduction at all was the statement that the child had received a contusion to the humerus two years previously, but had complained of discomfort only a few days. The incident that brought the child under observation was a fall and fracture of the humerus. The cyst involved the upper half of the shaft. How long, shall we say, have the symptoms been present? So that in the table of the duration of the disease of these cysts and *ostitis fibrosa* it is quite possible that the trouble was present many months before it had given any evidence of its existence.

Among the cases of bone cysts and *ostitis fibrosa* and Group B—cysts due to other conditions—the duration of the disease in 30 cases is estimated as less than two years, and in 29 cases from two to ten years or more; there are 14 cases of less than six months' duration, 6 cases between six months and one year, and 10 cases between one and two years; there are 11 cases between two and five years, and 18 in which the symptoms had been present over five years. We might, therefore, state that in at least 29 cases the more malignant medullary sarcomas could be excluded by the duration of the disease, but medullary giant-cell sarcoma cannot be excluded. In my personal study of 19 cases which I shall also take up in this paper, the duration of the disease in 7 varied from two to nine years.

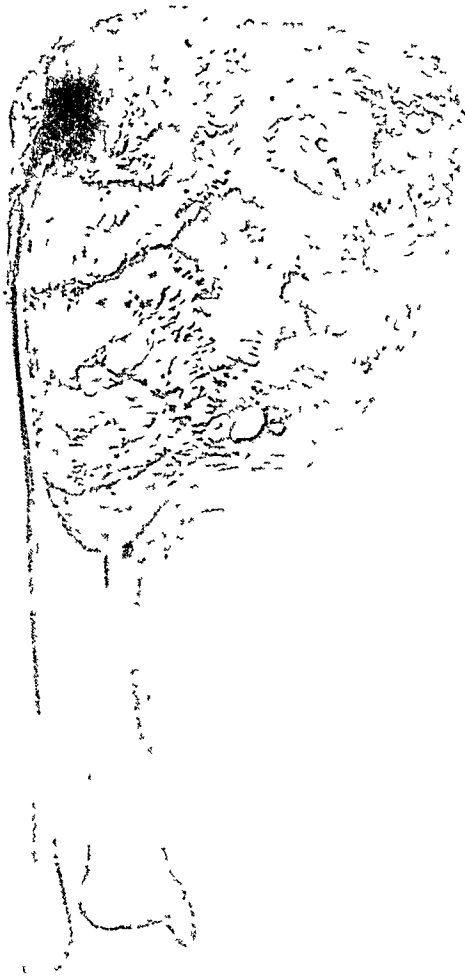
Symptoms of Onset.—Pain, swelling, and fracture are the symptoms. Fracture predominates. For example, in the 14 cases of less than six months' duration, 9 gave a history of fracture as the first symptom; pain without fracture was present in but 3; in only one did the patient seek advice because of swelling only. That is, in the 9 cases of fracture the

patients sought advice, because after the fracture, in a few, an X-ray revealed the cyst; in others, after the usual healing of the fracture, there was sufficient expansion of bone to indicate that a condition was present different from that to be expected after the healing of an ordinary fracture.

In the group in which the symptoms had been present from six months to one year, in 3 cases the condition was referred to a fracture, in 3 there was swelling only. In the group in which the symptoms had been present one to two years, fracture is mentioned four times, pain without fracture four times, swelling twice. In those patients in whom the symptoms had been present from two to five years, fracture was the symptom of onset in 8, a few had recurrent fractures; swelling alone was noted in 1 case, and pain in 2. In the 18 cases in which the symptoms had been present more than five years, fracture was the symptom of onset in 10, pain in 1; this patient had had pain ten years and a pathologic fracture ten days. In 3 cases there was swelling only, without fracture; in 2 there was a limp with slight curvature. This is the first time that I meet with limp as the symptom of onset. Both of these cases belong to the fourth variety—ostitis fibrosa of the femur. Here apparently the patients were unaware of the disease until the bending produced shortening and limp. In one case the symptom of onset was arthritis of the knee (Pfeiffer's second case); here the patient, aged 41, suffered from what was called arthritis of the knee at the age of 17; the cavity was at the lower end of the femur. In the healed bone cyst of my own observation, in which the swelling had been present twenty-two years, from the vague history of the patient one would infer that the first symptoms of the trouble were signs of infection.

These findings demonstrate how insidious the pathological process in the medullary cavity may be until a slight trauma produces a fracture. Even then the fracture heals, and the patient may not return under observation for years. Therefore, it may be fair to conclude that in all of these cases the only prominent etiological factor is a trauma, but we have no

FIG. 15.



Pathol No 7374 Photograph of a bone cyst of the upper end of the tibia taken from Labert's Atlas, p 167, also sent me by Dr Park of Buffalo.

FIG. 16.



Pathol. No. 8324. Photograph of a bone cyst of the lower end of the femur, removed by amputation. Longitudinal section through femur, cyst, and tibia. Note the abrupt expansion, the thick bone wall, and the single cyst. Compare with Figs. 14 and 15. The clinical picture and X-ray (Fig. 17) resemble the case illustrated in Figs. 9 and 10, but the cyst was single with a thick connective-tissue wall, and not a multiple cyst. The patient when she first observed the swelling was twenty years of age. The amputation was performed eleven years later by Dr. Cotton of Baltimore, because of hemorrhage after curetting the cyst. The patient recovered.

FIG 17.



Pathol. No. 8324. X-ray of case illustrated in Fig. 16, made three and one-half years after the onset of the swelling. In the following seven and one-half years before operation there was very little increase in size.

FIG. 18.



Pathol. No. 9718. Healed bone cyst lower end of fibula. Female aged forty, onset of swelling at age of sixteen; no symptoms for years. (Exploratory operation, Bloodgood.) The result in Colvin's case (Fig. 13) apparently resembles this.

positive evidence that the disease had its onset after the trauma. In fact, the evidence can be interpreted that the trauma simply reveals what has been present a longer period of time.

I, therefore, have been unable to find any definite etiological factor, and I cannot agree with those who look upon the lesion as the result of trauma, but it cannot be denied that there is some justification in considering the possibility of traumatism as a factor.

I agree with all the more recent investigators that the disease is an inflammatory one, in which the medullary tissue is replaced by a new formation of connective tissue with or without cyst formation, and that the term *ostitis fibrosa* is not an inappropriate one, although it would appear that the term *chronic osteomyelitis fibrosa cystica* or *solida* would describe the condition more fully.

Results of Treatment.—Curetting 38 cases, osteotomy for bending 3 cases, resection 6 cases, amputation 3 cases; no note 4 cases; autopsy specimens 5 cases. In 9 cases, therefore, an unnecessarily extensive operation was performed.

Among the cases subjected to curetting there are two deaths from hemorrhage and one in which it was necessary to amputate on account of the hemorrhage. Bockenheimer reports a huge cyst in the upper half of the shaft of the femur of at least twelve years' duration in a girl aged 17. Mikulicz had operated on this patient when she was 14; he simply injected iodoform without curetting; this individual also had a cyst of the tibia; the recurrent cyst was apparently of large size and belonged to the type in which there is no definite connective-tissue wall. Bockenheimer states that after curetting there was oozing and death. The other two cases have been mentioned before (see Figs. 9 and 16).

In the remaining 35 cases, as far as I am able to ascertain, there has been one definite recurrence. Koerte in 1870, after first curetting a cyst with a definite connective-tissue wall in the shaft of the femur, amputated under the diagnosis of sarcoma when the cyst reformed. Kehr curetted again in two

weeks. With these exceptions every case has remained permanently well after curetting. In my case it is seven years since the operation. Dr. Beck writes me that his two cases are well ten and seven years after operation; Dr. Corson informs me that his patient has remained well eight years. We, therefore, can feel reasonably certain of the permanency of the result after curetting.

The osteotomies have all been performed for *ostitis fibrosa* without cyst formation; these cases resembled the one reported by Kammerer (see Fig. 7). These operations were performed by Almerini, Von Brunn, and Whitman. In all cases the lesion was situated in the femur, and the indication for osteotomy was bending. The ultimate results in these three cases are not noted. I am inclined to venture the opinion that when bending is associated with cysts or *ostitis fibrosa*, curetting should be simultaneous with the osteotomy.

Resection has been performed by D'Arcis and Lexer for cysts of the femur and humerus without connective-tissue lining (my first variety). D'Arcis gives no explanation why he resected 22 cm. of the shaft, head, and neck of the femur, and implanted the fibula. Lexer resected the humerus and also filled the defect with the fibula. In his description he writes that, on exploring the cyst he found the bone shell so thin and in places entirely destroyed that he did not feel confident that simple curetting would accomplish a permanent cure, but might lead to later bending and refracture; for this reason he performed a subperiosteal resection. His result is an unusually good one, but I am confident that it is not as good as the results obtained by simple curetting alone, and in many of the cases subjected to curetting the shell of bone has been as thin and as perforated as in Lexer's case. I emphasize this, because it is my opinion that curetting should be attempted in every case. In the very large cysts the danger of hemorrhage should be borne in mind and a technic established to prevent it.

In Mueller's and in Braun's cases the cyst contained a connective-tissue lining. Mueller resected the metatarsal bone, Braun the upper two-thirds of the humerus, and filled the

defect from the anterior surface of the tibia with a good result. In the remaining two cases, Halsted did a subperiosteal resection of the femur for ostitis fibrosa containing a small cyst (see Fig. 5), while Boetticher resected the humerus under the diagnosis of osteosarcoma without an exploratory incision. This is the only case in which resection was done because of a definite diagnosis of sarcoma.

Koerte performed an amputation in 1870 because the cyst in the femur, curetted at first, reformed. Miessner's observation was in 1884; the amputation was apparently performed because of the history of many fractures during a period of eleven years in a boy of 18; as the result of these fractures and the cyst with a definite connective-tissue lining, the femur was shortened 16 cm. There is nothing in the report to suggest that Miessner looked upon the disease as malignant. The third case subjected to amputation has already been mentioned (see Fig. 16).

Multiple Lesions.—Cases in my own observation and those from the literature have been observed a sufficiently long time to conclude that the bone cyst and ostitis fibrosa may be localized in one bone. Yet, in this list of 69 cases, in 4 cases more than one bone has been involved. Von Brunn observed ostitis fibrosa without cyst formation in both femora and in the right tibia; osteotomy was performed, so we have no pathological report, nor is the ultimate result noted. In a case reported first by Von Mikulicz and later by Bockenheimer on account of a recurrence, there were typical cysts without connective-tissue lining in the lower end of the femur and in the upper end of the tibia. Pfeiffer curetted zones of ostitis fibrosa without cyst formation from both femora with a perfect result, while Tietze observed in the femur and tibia ostitis fibrosa with cyst formation.

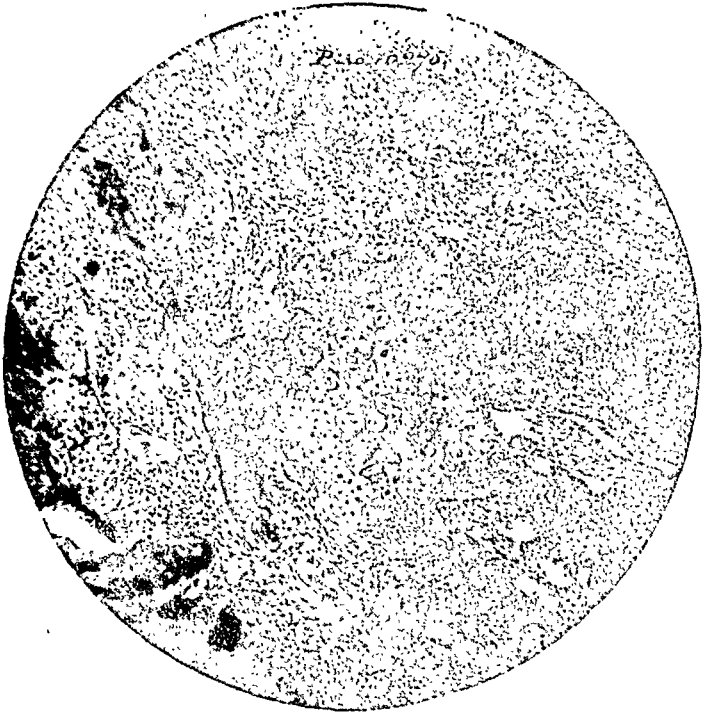
From these few cases ostitis fibrosa has been found more often than cysts in the multiple lesion.

Location of the Cysts.—The most common situation is the humerus, femur, and the tibia, about in the order named. In the humerus, cysts without and with a narrow connective-tissue

lining predominate. Ostitis fibrosa without cyst formation was observed in one case. Ostitis fibrosa without cyst formation of the type illustrated in Fig. 7 has been situated in the shaft of the femur in all cases but one. In the patient reported by Von Brunn the lesion was in the humerus; the patient was a boy aged 12 whom he saw eighteen days after an injury; a diagnosis of medullary sarcoma was made, but at the exploratory incision, after the removal of the thin shell of bone, the typical tissue of ostitis fibrosa was recognized; after curetting a cavity was left 10 cm. in length with normal marrow above and below; that is, the disease did not extend to the epiphysis; giant-cell areas were found, but no cartilage islands. Von Brunn allowed this cavity to fill with blood-clot and heal *per primam*. The result in this case eighteen months after operation, based upon function and X-ray, may be considered perfect. In two cases the lesion corresponded with variety 5 of Group A—multilocular cysts in ostitis fibrosa, similar to the case illustrated in Figs. 9 to 12. I emphasize this here, because Boetticher in his observation resected without exploratory incision, having diagnosed the lesion sarcoma. In the gross and microscopic pathology, in addition to the multilocular cyst formation, there were red and yellow areas between the septa in the expanded shell of cortical bone; the red areas resembled giant-cell sarcoma; the septa and yellow areas were histologically ostitis fibrosa; there were no islands of cartilage.

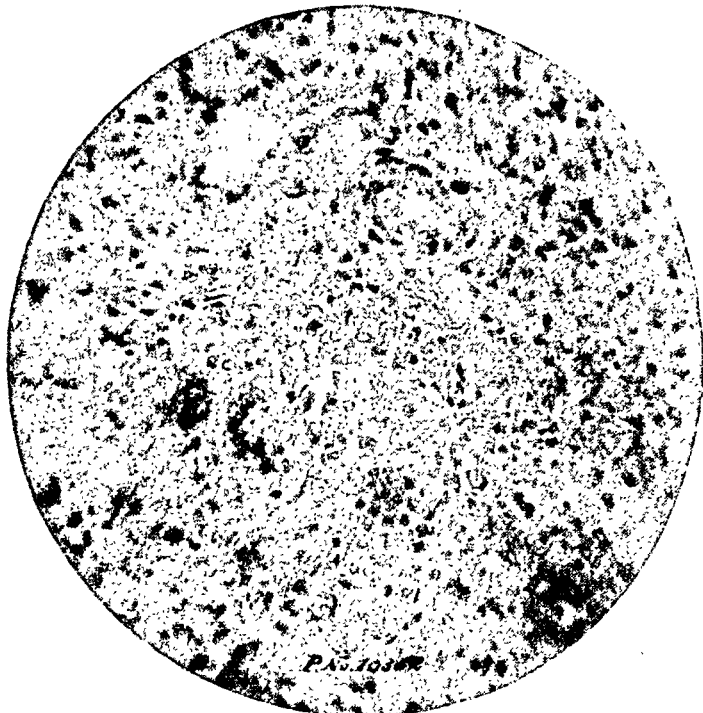
The multilocular cyst of this type is the least frequent of all the varieties of bone cysts and ostitis fibrosa: there are but five cases, because the one reported by Moenckeberg is the same case as that of Boetticher. The one described by Koenig was situated in the femur and resembled very closely my observation (see Fig 9.). Bostroem observed a similar pathologic condition in a sacrum at autopsy. Schmorl's case is incomplete. Ostitis fibrosa, therefore, is seen more often as a single cyst with or without any remains of connective-tissue lining,—38 cases,—or as a solid mass of fibrous tissue with or without small cysts—13 cases. The small number of the multilocular cysts—5 cases—should be emphasized, because

FIG. 19.



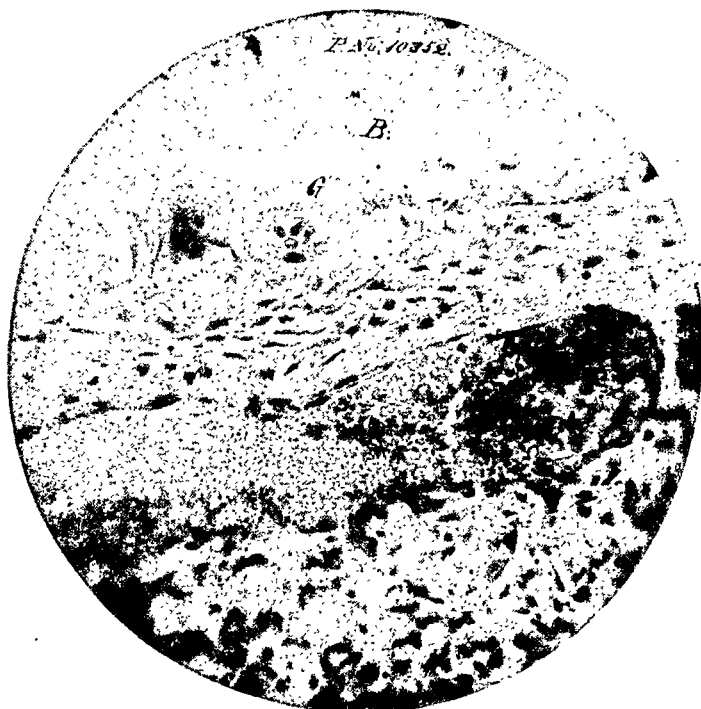
Pathol. No. 10275. Photomicrograph by Schapiro, showing islands of cartilage in the bone shell in which the bone lamellæ are separated by ostitis fibrosa. Patient of Dr. Leary of Boston. White girl aged five and one-half years, contusion of humerus two years without symptoms; recent injury (three days), fracture, X-ray very much like Fig. 1. Cyst in humerus extending to epiphysis. Operation January, 1910, curetting. The cyst contained no connective-tissue lining.

FIG. 20.



Pathol. No. 10352. Giant cells in a hemorrhagic area of ostitis fibrosa. Bone cyst of the humerus in which there was a definite connective-tissue lining. (Eisendrath's second case.)

FIG. 21.



Pathol. No. 10352. Photomicrograph (high power) of the bone shell (*b*), the giant-cell osteoclasts (*g*), and a very vascular area of the connective-tissue lining. (Eisendrath's second case, see Fig. 20.)

FIG. 22.



Pathol. No. 10474. Photomicrograph (low power) from section of bone shell and connective-tissue lining (Sowers' case, see Fig. 4). Note the giant-cell osteoclasts producing bone absorption.

FIG. 23.



Path No 10474 Photomicrograph (low power) from section of the bone shell in Sowers' case (see Figs 4 and 22) Here the ostitis fibrosa is filling the spaces between the bone lamellæ and there are minute cyst formations (C), suggesting the origin of the larger cysts

the differential diagnosis from myxochondrosarcoma might at first sight seem difficult.

In the femur every type of cyst has been observed; in the tibia the cysts of varieties 1 and 2 predominate; there is but one example of the solid *ostitis fibrosa*, and in this instance (Von Brunn's case) the femur was also involved; there is also one example of variety 3, that is, the *ostitis fibrosa* with small cyst formation; here also the femur was involved.

The benign bone cysts of varieties 1 to 5, therefore, are found prominently in the humerus, femur, and tibia; more often they extend to the epiphyseal line, but there are cases in which the disease involves the centre of the shaft only.

Colvin reports an X-ray of a benign bone cyst of the ulna. I find no recorded examples of cysts of any kind in the radius or in the metacarpal bones. The cases in the literature in which the cyst has been observed in the phalanx (X-ray) (Group B, variety 8) have all proved to be pure myxomas. In the clavicle I find no examples of bone cysts. Koenig reports two cysts in giant-cell sarcoma situated in the clavicle.

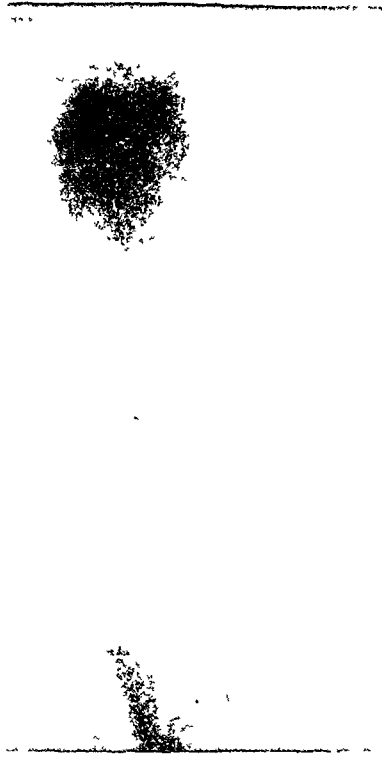
There is not an example of a true bone cyst in the pelvis. I have classified Bostroem's autopsy observations in variety 5—the multilocular cysts. The patient was a woman aged 25 who died after Cæsarean section; the cystic tumor filled the pelvis; it had a distinct bone shell and measured 4 x 11 x 11 cm.; the septa were both fibrous and cartilaginous. This observation could just as easily be grouped with my variety 7—cysts due to the liquefaction of solid cartilage tumors. Fleischhauer has reported such a cyst in the ilium of a girl of 20, and classifies it with Virchow's type. Chiari records a cyst in giant-cell sarcoma of the sacrum, and Deetz reported a cyst of the ilium due to a subperiosteal hæmatoma with ossification.

Practically, therefore, we can exclude the pelvis from involvement in the true cyst. I have observed a healed cyst in the lower end of the fibula (see Fig. 18). Mueller records a typical bone cyst with a connective-tissue lining in one of the metatarsal bones. Bostroem observed in the cadaver of a male aged 30 a cyst with a definite connective-tissue lining in the os calcis.

the study of the X-rays only. Daser also offers no anatomical proof for his diagnosis in a woman of fifty who had had symptoms of the disease fifteen years. The only observation I have been able to find recorded in American literature is by De Forest Willard and Andrus. Here also there is no anatomical proof. Kolisko is the only one with full anatomical study at autopsy, and he brings out the fact that giant-cell sarcomas are not always present.

Multiple Cysts in Osteomalacia.—The observations of Engel and Hirschberg are complete, both in the clinical history and autopsy. Clinically, Engel's case suggested osteomalacia: the patient was forty-two at the onset and lived thirteen years; the symptoms were emaciation, weakness, pain in the bones, and, some years before death, multiple fractures; the patient was bed-ridden. At the autopsy cysts from the size of a lentil to that of a hen's egg predominated in the picture; they were found everywhere—in the epiphyses and diaphyses, in long and short pipe bones and in flat bones; the largest cysts had a fibrous membrane; expansion of bone about the cysts was practically absent; there were no giant-cell tumors. Histologically, the tissue in the wall of the cysts corresponded more with *ostitis fibrosa* than with osteomalacia. Engel's observation was made in 1864, later Heinecke interpreted it as osteomalacia. Hirschberg's case observed in 1889 also allows more than one interpretation. Von Haberer classifies it with Von Recklinghausen's disease, Hirschberg himself with osteomalacia. Giant-cell tumors were present in this case. The disease had been present four years in a woman of thirty-five. It is rather interesting to note that the symptom of onset was swelling of the left clavicle; symptoms of other foci developed rapidly. Heinecke's case is most interesting on account of the X-ray studies. Clinically, the patient was twenty-four with symptoms of four years' duration following trauma to the left hip; she came under observation with pathological fracture of the left femur; the X-ray showed the multiple cyst. At the operation on the left femur Heinecke found a cyst with a connective-tissue lining. Heinecke interprets the microscopic
as osteomalacia.

FIG. 24.



Pathol. No. 4520. X-ray of giant-cell sarcoma of upper end of tibia (Bloodgood's case). Well seven years and five months after curetting. The shadow here is more like that of a bone cyst,—it has not the usual abrupt expansion of the giant-cell tumor.

FIG. 25.



Pathol. No. 4520. X-ray three months after operation in case shown in Fig. 24.

FIG. 26



Pathol. No. 4520. X-ray three years after operation in case shown in Figs. 24 and 25.

The localization of the single cysts in *ostitis fibrosa* is much more marked than when the disease is multiple in many bones. In the latter disease, phalanges of fingers and toes and other unusual sites have been the seat of the disease.

MULTIPLE CYSTS, OSTITIS FIBROSA, AND GIANT-CELL SARCOMA.

There is no doubt that the bone cyst, *ostitis fibrosa*, and the giant-cell sarcoma may be a disease localized to one bone. There are, however, examples of very similar pathological conditions affecting many bones. For this reason, whenever a patient comes under observation with clinically a single bone lesion, examination should be made as a routine practice with the X-ray for other bone lesions, and the urine should be examined for Bence-Jones bodies the finding of which, up to the present time, is considered a pathognomonic sign of multiple myeloma.

I have divided these multiple lesions into the following groups:

1. Multiple cysts in *ostitis fibrosa*: Von Recklinghausen's disease—twelve cases.

2. Multiple cysts in *ostitis deformans*: Paget's disease—five cases.

3. Multiple cysts in *osteomalacia*—six cases.

4. Multiple cysts in *enchondroma*: Virchow's type—two cases.

5. Multiple cysts in *sarcoma*—one case.

6. Multiple cysts in *mercurial poisoning*—one case.

I find no example in the literature of cysts in the multiple lesion myeloma. In practically all of the recorded instances of Von Recklinghausen's *ostitis fibrosa* of the entire skeleton cysts have been observed, while in Paget's disease and *osteomalacia* cyst formation is rather the exception than the rule. The multiple tumors—*enchondroma* and *sarcoma*—are of themselves very rare lesions. How often they occur without cyst formation I have not had the opportunity to ascertain.

Just what the practical side of these multiple lesions of bone will be in the future I am not prepared to state, but as the patients may live many years, perhaps we will learn from ex-

perience that operative intervention may give relief, prolong life and perhaps, in some cases, accomplish a cure.

Multiple Cysts in Ostitis Fibrosa.—This general disease of the skeleton was first described by Hirschberg in 1889, but he looked upon the lesion as osteomalacia with cyst formation. The disease for this reason owes its recognition and name to the contribution of Von Recklinghausen in 1891. In all of these cases there has been cyst formation; in seven out of the twelve multiple giant-cell tumors were also noted. I have been able to show that in the local lesion cysts are found with the rarest exceptions and giant-cell areas are frequently seen in the microscopic sections and sometimes in the gross.

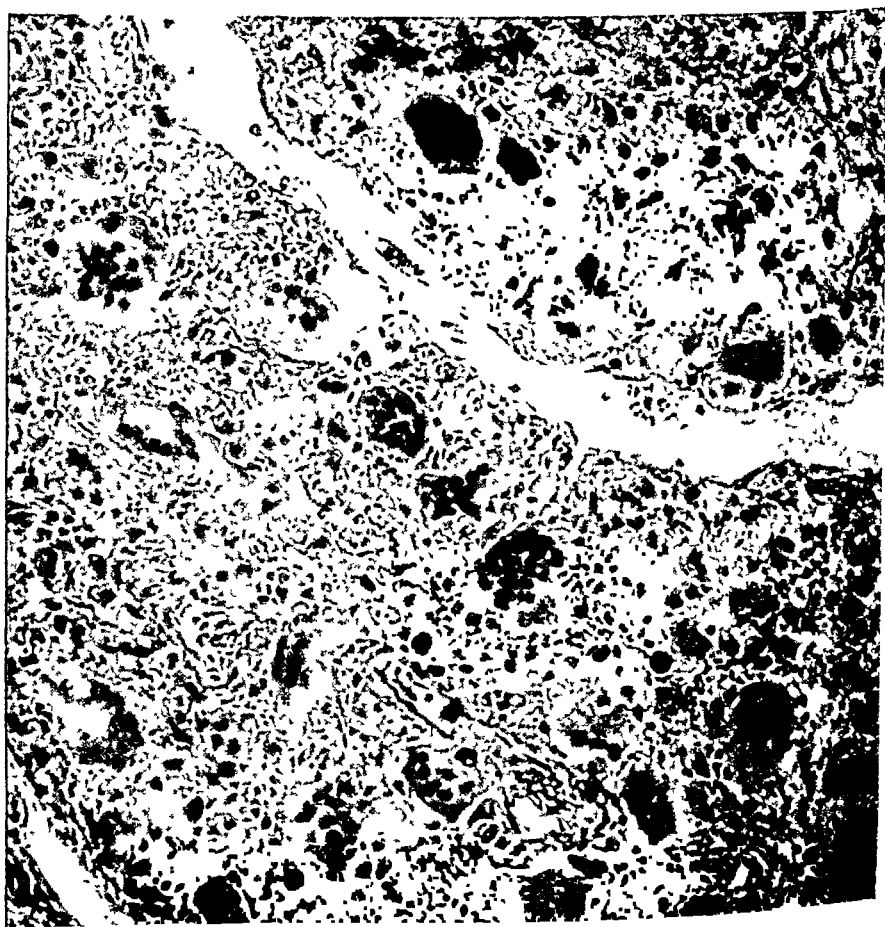
In the disease affecting the general skeleton the cyst formations are apt to be smaller and the giant-cell areas more numerous and larger. The symptom of onset as a rule is observed later. In about five out of twelve cases the patients were over twenty, two over fifty; the remaining seven were under twenty. Von Haberer's patient was three at the onset. The duration of life has varied from eighteen months to eighteen years, during which time the patients have suffered from one or more fractures, bending of the bones and multiple swellings. They frequently complain of so-called rheumatic or joint pains, and death takes place under the picture of marasmus. Although giant-cell tumors are found in many bones, in not a single instance has metastasis to internal organs been found. Rehn's contribution is one of the best because of a full pathologic study. The case published by Crile and Hill is the only one in American literature, except those discussed in my contributions to "Progressive Medicine." Crile and Hill interpret their observation as multiple giant-cell sarcoma, but it seems to me that it belongs to the group of Von Recklinghausen's disease.

Multiple Cysts in Paget's Disease.—There is considerable confusion in this smaller group, and all of these cases may really be Von Recklinghausen's disease. The patients are older, although Sonnenberg, in reporting three cases, observed one at sixteen years of age; the other two were aged sixty-one and forty-seven. In these cases the diagnosis was based on



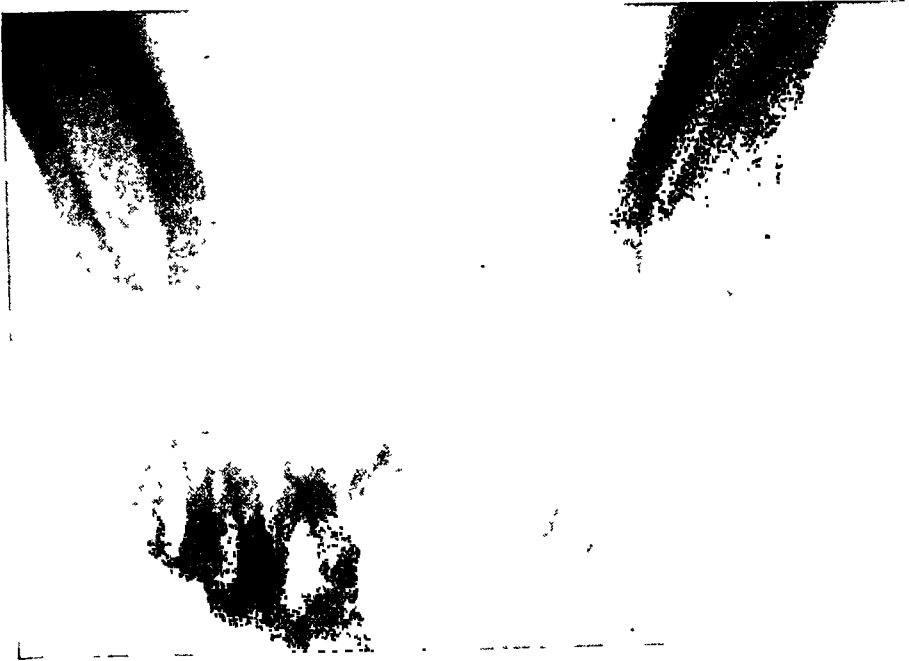
Pathol. No. 4520. Part of the tissue removed from the medullary cavity in the case illustrated in Figs. 24, 25, and 26. Note the broken-up cellular tissue. This is the appearance of a giant-cell sarcoma after hardening of the tissue in formalin or alcohol.

FIG. 28.



Pathol. No. 4520 Photomicrograph of section of tissue shown in Fig. 27. Typical histologic appearance of a giant-cell sarcoma.

FIG. 29.



Pathol. No. 6893. Giant-cell sarcoma of lower end of ulna. X-ray before operation.
Davis's case.

FIG. 30.



Pathol. No. 6893. X-ray of the result in case shown in Fig. 29 five years and five months
after operation.

FIG. 31.



Pathol. No. 7440. Giant-cell sarcoma. Photograph of alcohol specimen. Longitudinal section through femur showing medullary growth. Taylor's case.

FIG. 32.



Pathol. No. 9881. X-ray of a giant-cell sarcoma confined to the medullary cavity of the inner condyle of the femur, before first operation. DaCosta's case. See Fig. 33.

FIG. 33.



P. No. 9881.

Pathol. No. 9881. Photograph of a longitudinal section through the inner condyle of the femur removed by local resection. (See Fig. 32.) Note the central giant-cell sarcoma with cyst formation,—a distinct fibrous and bony capsule and areas of osteitis fibrosa as in Fig. 37.

Goldthwaite in Boston was good enough to send me X-ray pictures of multiple cyst formations in osteomalacia. The pathologic investigation was made by Dunlop. The symptom of onset was coxa vara. In Hart's case there were giant-cell tumors similar to those in Hirschberg's case. His patient was seventy-six; the cyst formations were numerous, also the fractures. In 1886 Rindfleisch called attention to cysts in osteomalacia.

The evidence, therefore, of marked cyst formation in osteomalacia is more conclusive than in Paget's disease.

Cysts in Multiple Enchondromas.—I have called attention to the relatively few observations of cyst formation in enchondroma—four cases, the first observation by Virchow. In the publication of Froriep (*Chirurgische Kupfertafeln*, 1831) there are illustrated autopsy findings which can be interpreted as cysts in multiple chondromas. Froriep looked upon them as hydatid cysts. The patient had suffered years with rheumatic pains, and before death there was a spontaneous fracture of the tibia. Virchow looked upon this observation as an example of Von Recklinghausen's disease. Koch mentions that Nélaton had reported a case of multiple cysts which he attributed to the liquefaction of primary solid cartilage tumors.

Single and multiple central enchondromas are rare, but undoubted examples have been reported. I have just had the opportunity to see with Drs. Le Conte and Longcope in the Pennsylvania Hospital of Philadelphia, a medullary lesion of the entire left femur which, in the X-ray and clinically, suggested osteitis fibrosa, but the tissue removed by Drs. Le Conte and Lee, when studied under the microscope is chiefly cartilage in places undergoing degeneration; here and there are islands of osteitis fibrosa; there are no giant-cell areas. The case, then, differs from my variety 4 (see Fig. 8) in that cartilage composes the principal part of the new formation in the medullary cavity, and osteitis fibrosa is observed only in small areas. This case is apparently unique up to the present time.

Multiple Cysts in Sarcoma.—The case reported by Westphalen and mentioned by Glimm, it seems to me, resembles Rehn's case of multiple osteitis fibrosa with cysts and giant-cell

tumors. The patient was over forty and came to the clinic complaining of pain in the knee of a few days' duration, but on examination multiple swellings of the bones were found which had been present six years, painful at first only. At the autopsy blood cysts were found in the epiphyses of a number of bones and in the wall of the larger cyst in the tibia he found numerous round cells. It is unfortunate that the autopsy was so incomplete, because it would be very interesting if the diagnosis of Westphalen of cystic degeneration of multiple sarcoma could be supported by better evidence. The one unusual finding was the blood in the cysts which we have observed before in giant-cell sarcoma and especially in the bone aneurism.

Westenhoffer, discussed by Von Haberer, reports a multiple cystic condition of the entire skeleton which he attributes to mercurial poisoning.

These diseases of the entire skeleton should be considered by the surgeon in his differential diagnosis. I have not mentioned multiple myeloma in detail, because so far no cyst formation has been observed in this disease, and, as I have stated before, the diagnosis is best made by an examination of the urine.

GIANT-CELL SARCOMA.

There are two remarkable facts in my list of eighteen personally studied cases of medullary giant-cell sarcoma: first, every one of the cases is well to-day; second, of the eighteen cases ten—over 50 per cent.—were situated in the lower end of the radius. In my list of all sarcomas of bone the radius (all in the lower end) has never been the seat of any other tumor except this giant-cell sarcoma.

Cases Which Have Been Subjected to Curetting.

CASE I.—Pathol. No. 4520, tumor in upper end of tibia; patient aged twenty-nine, symptoms nine years after trauma. Operation (Bloodgood) December 4, 1902: April, 1910, well seven years and five months. This case has been reported by me in the *Johns Hopkins Hospital Bulletin*, vol. xiv, May, 1903. (Figs. 24, 25, 26, 27, and 28.)

CASE II.—No. 6893, tumor in lower end of ulna; patient aged two and one-half years; symptoms nine months. Operation by Dr. G. G. Davis, of Philadelphia, December, 1904. April, 1910, well, five years and five months. This case has been reported by Davis in the *University of Pennsylvania Bulletin*, November, 1905, vol. xviii, p. 249. Dr. Davis in this paper gives credit to my publication in 1903 for suggesting to him the conservative operation, and my result which was known at that time seemed to justify it.

Through the courtesy of Dr. Davis and the kindness of the patient's father, who is a physician, I am able to reproduce the original X-ray made before operation (Fig. 29) and one of the results (Fig. 30) to-day, from which it is impossible to conclude that there had been any previous disease.

The description made by Davis of his operative findings describes graphically the typical picture of a giant-cell sarcoma containing a cyst. Davis writes: "An incision . . . revealed a thin shell of bone which on being removed exposed a cavity filled with 5 c.c. of thin dark-brown fluid; the cavity extended upwards, gradually diminishing in size until it ended half-way up to the elbow; it had a couple of ridges in it and laid near the surface; the cavity in its lower spherical part contained only brown fluid and no lining membrane; the upper conical portion was filled with a reddish granulation-looking material, soft in consistency, with no trace of any cartilage. The tissue was removed, and the cavity thoroughly curetted and packed with gauze. . . . The microscopic examination showed the growth to be a round-cell(?) sarcoma with numerous giant-cells."

The question which arises here is: can this case of Davis be looked upon as a benign bone cyst with osteitis fibrosa and giant-cell areas, or is it a true medullary giant-cell sarcoma with cyst formation (Fig. 38)? It differs from the other bone cysts which I have personally observed, and apparently from those in the literature. The cysts in giant-cell sarcoma which I have previously noted (p. 151) as variety 9 of Group B, apparently, from the meagre details given, resemble this case of Davis. I wish to emphasize here that in this medullary lesion which has remained well now over six years after

cureting, the fluid contents was not hemorrhagic, as observed in my three cases of bone aneurism. In this observation of Davis's apparently all the solid tissue resembles, in the gross and microscopic, the giant-cell sarcoma. Nothing suggestive of *ostitis fibrosa* was found, but as sections of the bony shell were not made, this cannot be excluded. I mention this fact here, because in some of my cases of giant-cell sarcoma I have demonstrated large areas of *ostitis fibrosa*.

CASE III.—Pathol. No. 7440, tumor in the lower end of the femur in a white male, aged twenty-two, symptoms of five months' duration, probably after trauma. January 26, 1906, Dr. Wm. J. Taylor, of Philadelphia, curetted; there was local recurrence in a few months and amputation was performed by Dr. Taylor. This patient at the present time—four years and three months since the first operation—is well.

This case is interesting, because the symptom of onset first observed by the young athlete who was a tennis player, was weakness of the left knee; pain and discomfort followed; swelling was late. Dr. Taylor notes that the general condition of the patient suggested *anaemia*, but there was no blood count. The X-ray was pretty typical of a medullary tumor preserving a bony shell. It is interesting to observe that a few days before operation, and while at the hospital, the patient had some fever. Dr. Taylor writes me as follows with regard to the operation:

"On cutting down to the bone it was found to be soft, and the knife readily entered a cavity which involved the whole of the lower end of the femur; a large quantity of soft, broken-down and unhealthy tissue was scraped out with the curette. . . The cavity thus cleaned out was large, and my finger-tip could sweep around the whole of the wall, which seemed to be smooth and unbroken at any point. The bleeding was profuse, so much so, that it was necessary to pack firmly. . . . There was tremendous oozing of blood for days, and all the packing was not taken out for a long time. Gradually the cavity filled with granulation tissue and finally closed."

I wish to call attention to this description by Dr. Taylor of the diffuse bleeding when a medullary giant-cell sarcoma is curetted, and I should advise the routine employment of the

FIG. 34.

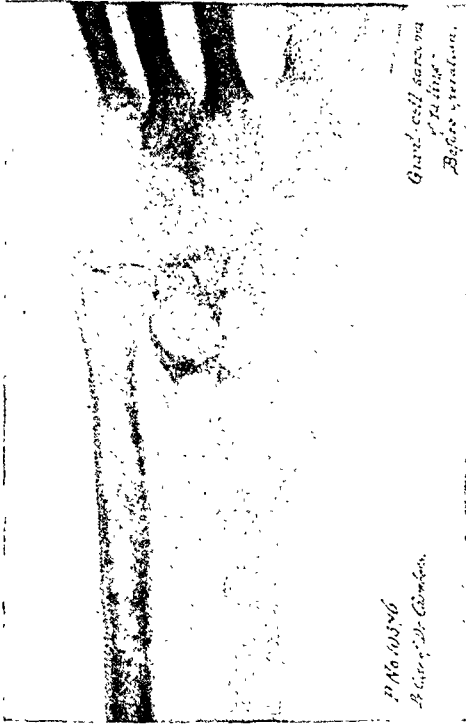
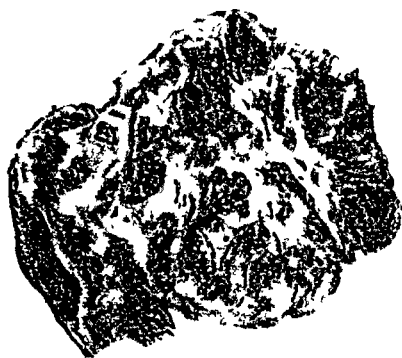


FIG. 35



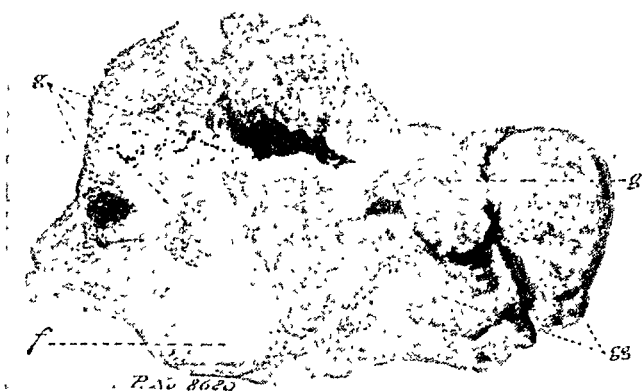
Pathol. No. 10376. X-ray of medullary giant-cell sarcoma of lower end of radius. Chambers's case.

FIG. 36.



Pathol No. 8412. Painting of fresh appearance of giant-cell sarcoma (Bloodgood's case), recurrent in the lower end of the radius.

FIG. 37.



Pathol. No. 8680. Giant-cell sarcoma of lower end of radius of at least six years' duration. Photograph of section of fresh specimen showing the definite fibrous capsule; the bony shell has almost disappeared. The red, currant-jelly areas (*g*), the definite white areas of osteitis fibrosa (*f*), and the mottled red and white areas of the mixed giant-cell tumor and osteitis fibrosa (*gg*).

FIG. 38.



Pathol. No. 7851. Medullary giant-cell sarcoma of lower end of femur. Photograph of section through femur and tibia. Interesting on account of the cyst formation in a typical giant-cell sarcoma. Patient of Dr. Mitchell of Washington. Well two and one-half years since amputation.

FIG. 39.



Pathol. No. 6471. Bone aneurism. Blood cyst at lower end of tibia. Spindle-cell sarcoma in wall of cyst. Mistaken at first operation for benign bone cyst. Death one year later of metastasis. Finney case.

Esmarch, which, I am quite certain, allows a more thorough curetting, and after this a disinfection of the cavity with pure carbolic acid, followed by alcohol and later by boiling water, as recommended by Von Eiselsberg, and even the use of the Paquelin cautery. If one is able to compare my case in the upper end of the tibia with Dr. Taylor's in the lower end of the femur, there seems no reason why he did not obtain an equally good result; there was, however, some difference in the technic: I employed the Esmarch and am quite confident that thanks to this I was able to curette more thoroughly; then the cavity was disinfected with pure carbolic acid a number of times; when the Esmarch was removed the bleeding was so profuse from the bone shell that I replaced the Esmarch and lined the cavity with wax; I then packed gauze into the cavity with a hammer and chisel; there was no bleeding when the Esmarch was removed.

The danger of hemorrhage in curetting a giant-cell sarcoma, especially in the large bones, should be borne in mind, and before proceeding with the operation one should be prepared to deal with this complication promptly.

I have been able to study the tissues removed by Dr. Taylor at the first operation with the curette and through his courtesy I have the specimen obtained by amputation (Fig. 31). This case is interesting, because it is one of my examples in which in a giant-cell sarcoma there are areas of *ostitis fibrosa*. I am sorry that Dr. Taylor could not see his way clear to attempt a second curetting. I will bring forth evidence that in giant-cell sarcoma repeated curetting has not shown any danger of metastasis, and now and then has accomplished a cure after two or more trials.

CASE IV.—Pathol. No. 9881, tumor of lower end of femur (Fig. 32). The tumor was removed by the curette in March, 1909, by Dr. J. C. DaCosta, of Philadelphia. It was confined entirely to the inner condyle of the lower end of the femur. There was recurrence, and in June, 1909, I was given the opportunity by Dr. DaCosta to study the sections of the tumor and the X-ray of both the primary and the recurrent medullary tumor.

In my list of eighteen cases the curetting has been attempted seriously in five; three of these have remained well: my own in the upper end of the tibia, Davis's case in the lower end of the ulna, and Chambers's case in the lower end of the radius. Two cases have recurred: patients of Drs. Taylor and Da Costa, but these patients are apparently well: one after amputation of the femur and one after resection of the inner condyle of the femur. In two cases the curetting, which was done before the patient came under observation, cannot be looked upon as more than an exploratory incision.

Cases from the Literature in Which Curetting Was Done.

Up to the present time my study of the literature is not complete, and it would be impossible to delay this paper for its completion. It is interesting to note, however, that up to the present time we have collected nineteen cases of undoubted giant-cell sarcomas among which six were curetted: in one only did the tumor recur and the patient remained well since local excision. The cases are as follows:

O. Kocher: Left tibia, well three years. Age 26, symptoms 2 years and 3 months.

Kramer: Lower end of femur, well twelve years. Age 16, symptoms 6 months.

Kramer: Upper end of humerus, well eight years. Age 13, symptoms nine months.

Karewski: Shaft of femur, well four years. Age of patient and duration of tumor not stated.

Kopfstein: Fibula, well two years and four months. Age 8, symptoms ten months. In this case there was recurrence four months after curetting, and the tumor was then excised.

Hinds: Lower third of femur, well two years and six months. Age 34, symptoms fifteen months.

These results are therefore somewhat better than among the cases I observed. Kocher's successful case somewhat resembles mine in its position in the tibia, although in his case the tumor was situated in the lower end of the tibia. It is very important to note that in three of the five successfully curetted cases the tumor was in the femur, two in the lower end and one

ft. I emphasize this, because from the experience

of Drs. Taylor and Da Costa one might be unwilling to attempt curetting here.

Of the remaining thirteen cases all of the patients have remained well, a number of them longer than four years since operation. The relative frequency of giant-cell sarcoma in the lower end of the radius in this group is less than in mine: three instead of ten. But it must be borne in mind that this list from the literature is by no means complete.

The following cases have been found in the literature and are noted here, because the tumors were curetted: some of these may be giant-cell sarcomas.

Wiesinger. Femur, upper third; patient aged fifty years; tumor a myxochondrosarcoma. Recurrence in three months, amputation. Well six years.

Kocher: Right tibia. Recurrence one month after curetting, amputation. Well twenty years. The patient's age was forty-eight, symptoms two years. Kocher simply says it is a myelogenous sarcoma.

Jenckel: Upper third of femur, in trochanter minor. Well twelve and one-half years. Age twenty-two, symptoms four and one-half months. Jenckel describes a bony shell containing a blood-cyst. This suggests a tumor similar to that in Davis's case in the lower end of the ulna.

The evidence, therefore, in the literature favors the position taken in this paper that curetting in selected cases is justifiable.

The Diagnosis of Giant-cell Sarcoma.—The age of the patient in my list with one exception has varied between twenty and sixty-six at the onset of the symptoms. The patient of Davis was two and one-half years of age. This is a very interesting fact. I have previously stated that the age of onset of the medullary benign cyst or osteitis fibrosa is rarely over twenty; now we find that the medullary lesion which casts a somewhat similar shadow in the X-ray is rarely observed under twenty and may arise as late as sixty-six. It is fortunate, therefore, that throughout life we may expect this benign, or rather less malignant, medullary disease, and it is this fact that makes it imperative to explore every medullary tumor seen in the X-ray or exhibiting itself clinically with swelling or pathologic fracture, before resorting to amputation.

In the literature there are a few cases of medullary giant-cell sarcoma under twenty years of age—enough to show that the giant-cell sarcoma is much less infrequent in patients under twenty years than the bone cysts in patients over twenty.

The duration of the tumor in giant-cell sarcoma has varied from five weeks to nine years, both in my cases and in those noted in the literature. In quite a number of cases the bony shell has been perfectly preserved after the symptoms had been observed a number of years; in my case nine years. When the symptoms have been present over two years the more malignant medullary sarcomas can practically be excluded.

In my table of cases trauma has been an etiological factor in every case, in a few there has been a definite fracture (two of the medullary giant-cell sarcomas of the lower end of the radius were associated with Colles's fractures). Pain is not a very prominent symptom, but it is practically always present, and there is tenderness; expansion of bone takes place sometimes a number of months after the local pain and tenderness. As a rule the expansion is slow. In contrast to the cysts in osteitis fibrosa, on one hand, and the more malignant medullary sarcomas, on the other, pathologic fracture in my experience has not been observed in giant-cell sarcoma. The X-ray shadow does not differ at all from that of a bone cyst (Figs. 24 and 29). It is true, that as a rule in a giant-cell sarcoma the distention of the bone is more abrupt and circumscribed (Figs. 32 and 34). That is, the involvement of the medullary cavity in the longitudinal diameter of the bone is much more limited than in bone cysts (Figs. 1, 2, 4), but the distention of the part involved is greater. Both in bone cysts and in giant-cell sarcoma, we may have great distention of the marrow cavity with the preservation of the bony shell, while in the more malignant medullary sarcomas the tumor as a rule grows directly through the bone without producing much distention. In multiple myeloma the shadow does not differ in the early stage from bone cysts or giant-cell sarcoma. In my experience, in the fully developed bone cyst or giant-cell sarcoma, one would be able to exclude with considerable certainty any

other medullary lesion, except the myeloma when occurring as a single lesion, but I can imagine that in the very early stage of the more malignant medullary sarcoma the shadow could not be differentiated from that of the cyst or giant-cell sarcoma. For this reason the ultimate diagnosis must rest until the exploratory incision is made.

I wish to emphasize this difficulty in the X-ray plate. My more recent experience has demonstrated that as we see bone lesions, both medullary and periosteal, earlier we find positive differential diagnosis from the X-ray more and more difficult.

Again, giant-cell sarcoma in a few instances may break through its distended bony shell and produce a periosteal tumor, infiltrating the soft parts. In a case situated in the lower end of the radius of but three months' duration the bone capsule was destroyed and the joint and soft parts infiltrated. In this case there had been repeated traumatism. The patient, however, has remained well twelve years after amputation. In this case, I am inclined to think, the infiltration of the soft parts was too extensive for an attempt even at resection. Clinically and in the X-ray this case had the characteristic features of the most malignant type, yet in the gross it was recognized as the hemorrhagic giant-cell tumor, and this was confirmed by the microscope. In a second case in which the tumor was situated in the lower end of the radius, it would be impossible to make out a bony shell in the X-ray, and the operation revealed infiltration of the soft parts, yet the tumor was a giant-cell sarcoma, and the patient has remained well ten years since amputation.

The medullary giant-cell sarcoma may now and then exhibit the features supposed to be characteristic of the more malignant types.

There is evidence that infiltration of the soft parts outside the bone capsule in medullary giant-cell sarcoma need not be looked upon as positive indication for amputation. Resection is justifiable, provided after the removal of the disease a limb with useful function will be preserved. In 1892 Dr. Halsted resected the lower ends of radius and ulna for a pulsating

periosteal tumor surrounding the ulna. The patient was a colored woman aged forty-five and the tumor had been present one year. It is the only giant-cell sarcoma in which pulsation has been noted. At the operation the tumor had the characteristic appearance of the giant-cell neoplasm. In the tissues removed I have demonstrated with the microscope that the zone of uninvolved muscle removed beyond the tumor was so narrow that it all can be seen in one field under the low power of the microscope. Yet this patient remained well twelve years since the operation, and died of other causes. The function of the arm was fair.

The local growth of giant-cell sarcoma is usually circumscribed, even when it is periosteal, but now and then a certain degree of infiltration is noted.

The Fresh Appearance of Medullary Giant-Cell Sarcoma.—I have now seen giant-cell sarcoma in the medullary cavity of the long pipe bones about twelve times, and in addition I have observed it in the fresh twice in the medullary cavity of the lower jaw, and, perhaps, as a periosteal epulis ten or fifteen times. In all the other cases I have observed the tissue only after hardening in alcohol or formalin. I have been struck by the uniformity of its fresh appearance (Fig. 36). It differs from the periosteal and medullary sarcoma of the spindle-, round-, or mixed-cell type by its color. It is distinctly vascular; it resembles to a certain extent young granulation tissue. The appearance can be well described as that of currant-jelly, and I find this term employed by many others in the literature. Mixed with the red areas there may be white areas, and areas mottled, white and red (Fig. 37). The second characteristic feature is the consistency of the tumor. There seems to be a complete absence of any supporting stroma. It can be broken up with the finger or the curette into small pieces (Fig. 27), and one sees not even the finest connective tissue holding the pieces together, yet it does not break up into finely granular masses characteristic of the very cellular round-cell sarcoma. The consistency resembles to a certain extent "Schmierkaes." In a few instances the white areas are quite firm and fibrous, then we have an admixture of osteitis fibrosa.

It is very remarkable that this vascular, cellular tumor is in its growth just as circumscribed as a fibro-spindle-cell fibroma or fibrosarcoma. The giant-cell sarcoma tissue can be removed from its bony shell as easily as the connective-tissue lining of a bone cyst, in fact it is less infiltrating than the fibrous tissue of the latter. In many cases the giant-cell tumor cannot be demonstrated deep in the bony capsule.

Microscopically (Fig. 28), giant-cells somewhat of the osteoclast type predominate in the picture. Without these giant cells the histologic structure suggests granulation tissue: there are numerous endothelium-lined blood spaces separated by connective-tissue stroma filled with spindle and round cells, but here we find very little of the eosin-staining fibrous tissue and very few fibroblasts; the giant cells are often seen in the endothelium-lined space, and some investigators have looked upon the giant cells as the product of endothelial budding.

BONE ANEURISMS.

I have observed three cases of bone aneurism—a term employed in the literature to describe a hæmatoma in a very malignant medullary spindle- and round-cell sarcoma. In only one of these cases was there any difficulty in making the differential diagnosis. I will describe this case first,—as it has many unusual features.

CASE I.—Pathol. Nos. 6326 and 6471. Bone aneurism in lower end of tibia. Male, aged thirty-five. This patient for twenty-five years, since ten years of age, has had pain and swelling in the region of the left ankle. At the onset, on account of the pain, he was confined to bed fourteen months. Since then the swelling has remained and he would only have recurrent attacks of pain. The condition has been diagnosed arthritis. Six weeks before operation, on account of the recurrence of the pain, he consulted Dr. Hamburger, who referred the patient to Dr. Finney. The swelling and pain were confined to the lower end of the tibia. An X-ray was taken and the shadow was looked upon as indicating a bone cyst. At the operation the cavity contained blood clot and was lined by tissue resembling organized blood clot. Curetting was done. The tissue which I received in the labora-

tory consisted chiefly of blood clot and organized blood clot. From the sections it was very difficult to make a positive diagnosis. There were hemorrhage, granulation tissue from the organization of the blood clot and a tissue very rich in spindle and round cells in which there were a number of giant cells.

The first operation was performed April 28, 1905. The cavity filled so rapidly with a hemorrhagic tissue that one could feel quite certain that it was not a benign cyst, and even a giant-cell sarcoma, from our present-day experience, could be excluded from this very rapid growth filling the cavity. I saw the patient with Dr. Finney at the second operation June 14, 1905. The tissue of the medullary tumor had now broken through the bone in places and infiltrated the soft parts. The growth was pearly-white in color and coarsely granular—not at all the appearance of giant-cell sarcoma, but that of a spindle-cell sarcoma. In the centre of the cavity was organized blood clot. As the tumor had infiltrated beyond the hope of local excision, amputation was performed. The patient died about one year after the second operation with evidence of internal metastasis.

When we examine critically the specimen (Fig. 39) we find that there is not a distinct shell as seen in bone cysts or giant-cell sarcoma, but a cortical bone varying in thickness, irregularly eroded by the infiltrating tumor which in places has perforated it. When we examine the sections we can understand the difficulty of diagnosis from the tissue removed at the first operation, because the organized blood-clot tissue covering the surface of the tumor has, in places, no evidence of the tumor at all: it shows organized blood clot containing a few giant-cells, while the tumor itself is a pure spindle-cell sarcoma without giant cells. That is, at the first operation we examined the hemorrhagic contents and little or nothing of the tumor proper.

CASE II.—Pathol. No. 2881. Bone aneurism in the upper end of the femur. The clinical picture was looked upon as so characteristic of a malignant sarcoma and so extensive that a shoulder-girdle amputation was done by Dr. Cushing without exploratory incision. The patient lived four years and died with evidence of local recurrence and internal metastasis, the symptoms of which had been present four months before death. The patient was a male, aged thirty-two, and had suffered pain in the region of the right shoulder four years; the pain was

worse after a hard day's work, yet there was no weakness or swelling. Six months before operation, after a contusion of the shoulder, there was very rapid swelling with the formation of the tumor shown in Fig. 40. The specimen (Fig. 41) exhibited a huge cavity filled with blood clot, with complete destruction of the bone. A piece of the head (*h*) is preserved and the shaft (*s*) ends abruptly in the hæmatoma. This cavity has a thin connective-tissue capsule (*c*). Only under the microscope was I able to make out a thin zone of tumor tissue—a spindle-cell sarcoma.

CASE III.—Pathol. No. 8951. Bone aneurism in the lower end of femur. White male, aged twenty-one. Sustained a traumatism to the knee four months ago, followed by swelling on the inner side, severe pain and stiffness of the knee. Six months before operation the exploratory incision was made, and there has been a discharge of blood from sinus since. The cavity was explored by Dr. Finney, who found a huge hæmatoma. In the tissue removed with the curette I demonstrated with the microscope only the presence of round-cell sarcoma (Figs. 42 and 43). As the condition was looked upon as incurable, the patient was allowed to go home. I am informed that he died a few months later of metastasis.

With our experience with bone cysts, *ostitis fibrosa* and giant-cell sarcoma I am of the opinion that the bone aneurism, if seen in the early stage as in my first case, can be recognized by the hemorrhagic contents which is never present in bone cysts and, so far in my experience, is very rare in giant-cell sarcoma. When present in giant-cell sarcoma, the cyst is a relatively small affair and the characteristic giant-cell tissue is present in large quantities about the cyst. [See Davis's case (Fig. 29) and Mitchell's case (Fig. 38)].

These three personally observed cases have in common a cavity filled with clotted blood. In two cases the bony shell had been partially or completely destroyed; in one, that situated in the lower end of the tibia, the bony shell at the first operation was apparently preserved, but at the second operation the tumor tissue had infiltrated through bone shell into the surrounding tendons and muscle. In not one of these three cases

tory consisted chiefly of blood clot and organized blood clot. From the sections it was very difficult to make a positive diagnosis. There were hemorrhage, granulation tissue from the organization of the blood clot and a tissue very rich in spindle and round cells in which there were a number of giant cells.

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CASE II.—Pathol. No. 2881. Bone aneurism in the upper end of the femur. The clinical picture was looked upon as so characteristic of a malignant sarcoma and so extensive that a shoulder-girdle amputation was done by Dr. Cushing without exploratory incision. The patient lived four years and died with evidence of local recurrence and internal metastasis, the symptoms of which had been present four months before death. The patient was a male, aged thirty-two, and had suffered pain in the region of the right shoulder four years; the pain was

worse after a hard day's work, yet there was no weakness or swelling. Six months before operation, after a contusion of the shoulder, there was very rapid swelling with the formation of the tumor shown in Fig. 40. The specimen (Fig. 41) exhibited a huge cavity filled with blood clot, with complete destruction of the bone. A piece of the head (*h*) is preserved and the shaft (*s*) ends abruptly in the hæmatoma. This cavity has a thin connective-tissue capsule (*c*). Only under the microscope was I able to make out a thin zone of tumor tissue—a spindle-cell sarcoma.

CASE III.—Pathol. No. 8951. Bone aneurism in the lower end of femur. White male, aged twenty-one. Sustained a traumatism to the knee four months ago, followed by swelling on the inner side, severe pain and stiffness of the knee. Six months before operation the exploratory incision was made, and there has been a discharge of blood from sinus since. The cavity was explored by Dr. Finney, who found a huge hæmatoma. In the tissue removed with the curette I demonstrated with the microscope only the presence of round-cell sarcoma (Figs. 42 and 43). As the condition was looked upon as incurable, the patient was allowed to go home. I am informed that he died a few months later of metastasis.

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These three personally observed cases have in common a cavity filled with clotted blood. In two cases the bony shell had been partially or completely destroyed; in one, that situated in the lower end of the tibia, the bony shell at the first operation was apparently preserved, but at the second operation the tumor tissue had infiltrated through bone shell into the surrounding tendons and muscle. In not one of these three cases

was there a sufficient wall of tumor tissue to recognize it at the exploratory incision.

As compared with the benign bone cysts these hæmatomas in the medullary cavity can be distinguished by the contents of the cavity. In the benign bone cyst the contents is never so hemorrhagic.

Although giant-cell sarcomas are very vascular, cysts, especially hemorrhagic cysts, must be very unusual. The cyst in Davis's case, in the lower end of the ulna, had an appearance not at all suggestive of a bone aneurism, but was rather more like the benign bone cyst. In Mitchell's case (Fig. 38) the cyst is but a small part of the giant-cell sarcoma of the lower end of the femur. In my personally studied cases of giant-cell sarcoma I have not observed anything at all like these three cases of hæmatoma in medullary spindle- or round-cell sarcoma. For this reason I have turned to the literature for aid. In Group 9, cysts in giant-cell sarcoma, which have gotten into the literature among the benign bone cysts, there is not sufficient detail to give the exact contents of the cyst. Apparently the bony shell was preserved, the cyst was but a small affair in the centre of a giant-cell tumor, and there was nothing in these cases to suggest a bone aneurism.

But medullary sarcoma may present itself with a clinical picture suggestive of what might be called a bone aneurism. There have been three cases sent to surgical pathological laboratory, two of these from Dr. Halsted's clinic. That is, among thirteen medullary spindle- and round-cell sarcomas three have been the seat of central hæmatomas.

Nakayama (*Beiträge z. klin. Chir.*, 1909, lxiv, 524), in 1909, reports three cases from Garré's clinic in Bonn, and adds some new cases to those already collected by Gaylord (*ANNALS OF SURGERY*, vol. xxxvii, 1903, 834).

It is very difficult to classify these cases, many of which are from the older literature and without pathological study. They all seem to have one feature in common—a central hæmatoma. In every properly studied case there has been a wall of tumor tissue, in a few cases giant-cell sarcoma, in the

majority the more malignant spindle- and round-cell sarcoma.

In some of the cases, clinically, there was pulsation, a few of these exhibited a bruit. In some of the older cases the injection of the larger artery demonstrated an arterial communication with the cavity in the bone. This is not unusual and should by no means be interpreted as an aneurism. In my observation of giant-cell sarcoma of the tibia, after curetting the tumor and removing the Esmarch one could see large vascular spaces in the bone, undoubtedly vessels. Taylor in curetting his giant-cell sarcoma of the femur comments upon the hemorrhage, and in three cases of the very large bone cysts hemorrhage was a marked feature. I have observed a periosteal giant-cell sarcoma of the ulna to pulsate, and am surprised that pulsation has not been noted in more cases of medullary giant-cell sarcoma. Up to the present time pulsation or bruit in a medullary bone tumor can be looked upon as a clinical sign excluding a benign bone cyst or *ostitis fibrosa*, but not the relatively benign medullary giant-cell sarcoma. The absence of a bone shell in places or almost entirely does not absolutely exclude medullary giant-cell sarcoma, but is suggestive of this more malignant medullary tumor with a central *hæmatoma*.

Nakayama's first case corresponds exactly with my Case III (Pathol. No. 8951). The patient was a male aged thirty-one, pain and swelling eight months; considerable expansion of the lower third of the femur, in places absence of the bony shell with fluctuation, but no pulsation or bruit; definite infiltration of the soft parts; at the exploratory incision a thin bony capsule, a wall 2 to 3 mm. in thickness, a huge *hæmatoma*; first diagnosis—giant-cell sarcoma; after amputation and more complete study this case was changed to spindle- and round-cell sarcoma. There was the usual result—death from local recurrence and metastasis.

Now, these two cases of bone aneurism or *hæmatoma* of the lower end of the femur could be differentiated from any case of bone cyst or giant-cell sarcoma that I have studied in this position.

Nakayama's second case resembles my second case (Pathol. No. 2881) in its position in the upper end of the humerus. At the exploratory incision there was a thin bony shell which

in places was destroyed and a cavity filled with blood clot and tumor masses; the muscles were infiltrated; microscopically, it was a round-cell sarcoma. The patient was a male aged eighteen, and the pain in the shoulder had been present two years, the swelling one year.

Nakayama's third case, from his description, might suggest a similarity with a benign bone cyst having a definite connective-tissue lining. As he is quite familiar with the literature on bone cysts and *ostitis fibrosa*, and as a careful microscopic study was made of the connective-tissue lining with the report of a spindle-cell sarcoma, one has no right to be skeptical. The case is unusual, because the patient was but four years of age. In my experience the malignant medullary tumors are very rare at this age, while the benign bone cysts are common. From his description of the X-ray there was apparently a pretty typical thin shell of expanded bone. The only difference from a benign bone cyst was found at the exploratory incision: the cyst contained dark blood under pressure and blood clot. In addition, there were areas in which the bone shell had completely disappeared. This is very unusual in the benign bone cysts of small size. That a microscopic study of the blood-clot *débris* may give rise to the diagnosis of giant-cell sarcoma is emphasized in this case, because giant cells were found in the hemorrhagic *débris*; the spindle-cell sarcoma only in the connective-tissue wall. In my first case and in Nakayama's first case a diagnosis of giant-cell sarcoma was tentatively made from the tissues removed at the first exploration.

In the literature there are numerous cases resembling those reported by Nakayama, Gaylord and my three observations, that is, *hæmatomas* in the more malignant spindle- and round-cell sarcomas. But among these cases collected by Gaylord and Nakayama, there are some that do not belong to this type. Roughton's case reported in 1890 answers every description of a benign bone cyst in a child of four, a cyst in the upper end of the tibia. To confirm this the child was well at the report three years after a partial curetting. Borst,

Luecke, and perhaps Schleich report examples of hæmatoma in giant-cell sarcomas. Luecke's case is very suggestive, because he describes the tumor as soft and red in color (this is giant-cell sarcoma) and with a cavity filled with blood. This patient was living three and one-half years after amputation. Borst's observation is interesting, because in the same individual there was a cyst in a giant-cell sarcoma situated in the lower end of the femur and one in the upper end of the tibia; no further details are given.

Hæmatoma of the so-called bone aneurism type are rare in giant-cell sarcoma.

Wythe's case resembles the cysts in periosteal hæmatoma with an osseous wall (Group B, variety 9), and is not a bone aneurism in the sense of a hæmatoma in a malignant tumor. These blood cysts in subperiosteal hæmatoma with an ossified wall resemble the blood cysts in ossifying myositis and are probably of the same type. It seems to me Oehler's case reported as a bone aneurism belongs to this group.

As I have not considered periosteal tumors in this paper I shall not go into details, but it is interesting to note that we have two benign extra-osseous hæmatomas which must be recognized from malignant disease presenting itself as a hæmatoma.

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MULTIPLE LESIONS OF BONE: CYSTS, OSTITIS FIBROSA, GIANT-CELL
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N. B.—The literature on giant-cell sarcoma will appear in a second communication. This bibliography is complete for the single and multiple bone cysts and associated lesions.

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MULTIPLE LESIONS OF BONE: CYSTS, OTITIS FIBROSA, GIANT-CELL
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N. B.—The literature on giant-cell sarcoma will appear in a second communication. This bibliography is complete for the single and multiple bone cysts and associated lesions.

NEOPLASMS AND OTHER TUMORS INVOLVING THE MAXILLARY BONES.

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INTRODUCTORY to the presentation of the subject of tumors of the alveolar process, it might be well to call attention to the unsystematic method in which the subject has been studied.

Bland-Sutton's classification of tooth tumors which was given to us many years ago has not been improved upon so far as embryological tumors are concerned. The consideration of the tumors of the bones entering into the formation of the face has been pretty well presented by the writer during the past. This, however, is not the case regarding tumefactions developing from the soft tissues overlying the alveolar processes.

The classification used here I think will make it much clearer for the student of oral surgery to grasp the differential points between connective-tissue and epithelial tumors. It will be observed that enlargements of the alveolar process that are inflammatory or infective in that they depend upon micro-organisms as a cause have not been considered, and that only the hypertrophies or cystic conditions associated with the teeth are included in this paper.

This subject is best presented by observing the following arrangement:

- A. Neoplasms of the soft tissues over the alveolar process.
- B. Chloroma.
- C. Bone tumors and cysts.
- D. Malignant tumors.

A. NEOPLASMS OF THE ALVEOLAR SOFT TISSUES.

Independent of odontomata and osteomata other neoplasms are found to develop from the soft tissues.

The most common forms are the following: (a) papilloma; (b) polypus; (c) hypertrophy; (d) fibroid and myeloid epulis.

a. *Papillomata*.—Several forms of growth develop from the gums and occur as elongated papillæ in the form of little tufts. Their centre is composed of mesoblastic tissue and they have a covering of the thickened epithelium. They are of the epithelial type. They have an irregular surface with a strawberry appearance. These tufts develop from the gingival margin about one or many of the teeth. The cause is some mechanical irritant as tartar, etc.

A typical case was that of a pregnant woman, aged twenty years, upon whom a radical operation was not advisable. The granulations were strawberry red and irregular, and bled freely upon the least irritation. At several points they grew as high as the crowns of the teeth and more than two-thirds of the teeth were included in the area of growth. Tartar was found throughout the lingual surfaces of the teeth.

Treatment.—This consisted in curetting the granulations back to the healthy mucous membrane. The hemorrhage was controlled with adrenalin solution. Tincture of iodine was applied to the wounds. The patient was seen twice every week for four or five weeks when all tendency to return had been controlled and she remained well when seen eight months later.

Fig. 1 illustrates a case of papillomatous growth of the gingival mucous membrane extending entirely around two teeth and including the third along the sides. It was removed by the use of a curette under local anæsthesia and followed by the application of commercial tincture of iodine. There was no return in several months. The surface was strawberry-like and bled under slight pressure.

Fig. 2 shows papillomata of the alveolar process and resembles the case illustrated in Fig. 1, save that its surface was not granular except at some points. Operation included the removal by the use of the knife under local anæsthesia. There was no return after several months.

There is a great tendency to return and even in three or four days they have been seen to grow an eighth of an inch

at points where it was thought they had been thoroughly removed by curettement. Thorough removal, cauterization and disinfection are essential if return is to be prevented. There is no tendency toward malignancy.

Fig. 3 shows a typical polypus of the process in a girl of eight years. The growth was over the alveolus with a distinct pedicle or contracted base attached to the lingual gingival margin. The surface, while slightly roughened, did not bleed as do papillomata. Operation was performed by severing the pedicle with a scalpel under a very mild degree of chloroform anæsthesia. There has been no return.

Fig. 4 shows a second case of polypus in a woman aged thirty years. It has been growing for several years. In physical appearance it was the same as in the preceding case. Operation was performed under local anæsthesia. Hemorrhage which was quite severe was controlled by pressure. Repair was prompt and there has been no return.

b. Polypus.—Polypi of the gums are seen quite frequently and resemble such growths in other parts of the body. They differ from the preceding in such that they are usually single, grow to considerable size and have a distinct pedicle, while the papillomatous variety is multiple, grows exuberantly and rapidly.

These tumors vary from the size of a pea to a horse-chestnut and are found on the gums in the neighborhood of diseased teeth. They are said to be caused chiefly by the ragged edge of a carious tooth, but it is probable that ptomaines from the operations of bacteria stimulate papillomatous growth upon granulating mucous surface and have more to do with their etiology than is usually supposed. The growths in question are essentially papillomatous, and exhibit on section large, branching papillæ, covered with a thicker layer than normal of squamous epithelium. The polypi are purely local in their origin and are non-malignant.

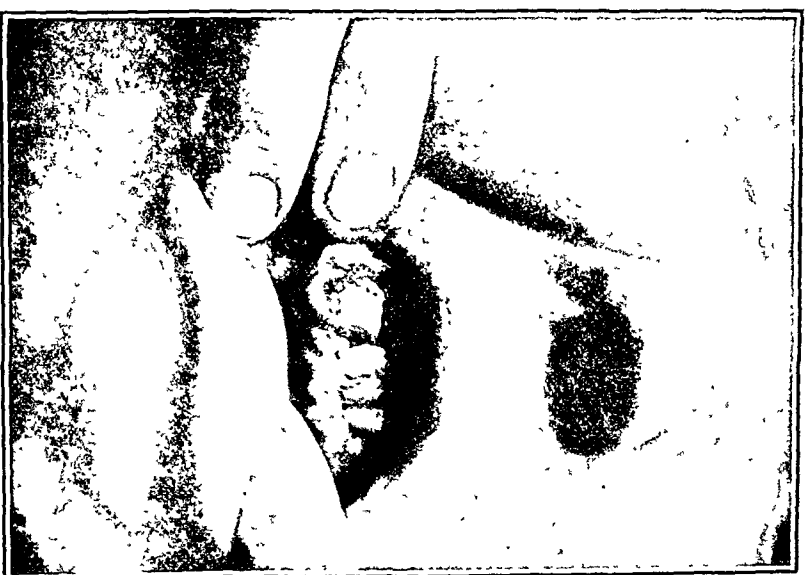
Treatment.—The treatment consists in removal under local or general anæsthetic. A scalpel or scissors may be used. no tendency to return. If there is return, the growth

FIG. 1.



Papillomatous growth of the gingival mucous membrane.

FIG. 2.



Papillomata of the alveolar process, resembling the case illustrated in Fig. 1.

FIG. 3.



Typical polypus of the alveolar process in a girl of eight years

FIG 4



A second case of polypus, in a woman of thirty.

will be from a new point of the gum, and not at the point of original growth.

c. *Hypertrophy*.—Hypertrophy of the soft tissues over the alveolus and independent of it is a growth of the connective tissue between the bone and mucous membrane.

The enlargement is uniform, developing on both sides of the process and extending around the teeth. The margin of the growth is not defined as in the former varieties, but disappears in the normal mucous membrane. The surface is covered with normal mucous membrane. There is almost a bony hardness resembling osteoma odontoma and malignant growths during their early history. There is little if any pain and no other local or constitutional symptoms. The condition may be the early stage of epulis, but the cases operated were very different from cases of this condition under observation. They resemble or may be identical histologically with fibroid epulis as heretofore understood.

Treatment.—Treatment consists in removal by excision. They are not malignant and there is usually no return.

Fig. 5 shows a case of hypertrophy of the left upper alveolar tissue in a woman aged forty-five years. It has been growing for 18 months. The surface was smooth, uniformly developed and without symptoms. Removal was done by cutting to the bone on both sides. The process was severed with a circular saw on a dental engine. The section was below the nasal and antral cavities. The bone was not involved. Repair was prompt and there was no return in two years, when the patient was last seen.

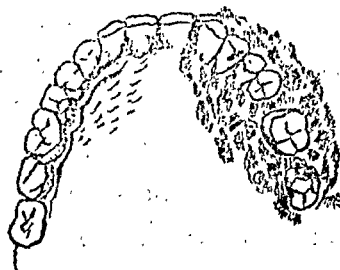
The second case (Fig. 6) is very similar to the foregoing. The patient was about thirty-five years of age. The enlargement involved the right upper process from the median line to about the first bicuspid. The teeth had previously been extracted. The operation was performed as outlined in the former case. Repair was prompt and there was no return.

A young man aged seventeen years had a congenital hypertrophy of the left side of the face and a growth of the left upper alveolus, as in Fig. 7. It uniformly involved the process through-

out the left side. It was spongy, the remaining teeth were loose and could easily be moved. Putrefactive bacteria had produced an extensive suppurative and offensive condition. Before a radical operation was done a section was removed to determine its histological character, and while it was difficult to say definitely, owing to the disorganized nature of the tissue, it most resembled a fibroma.

Operation consisted in a complete removal of the growth including the teeth and alveolar process up to the antral floor, care being taken not to destroy the membranous floor of this cavity at points where the bone was removed. Hemorrhage was

FIG. 7.

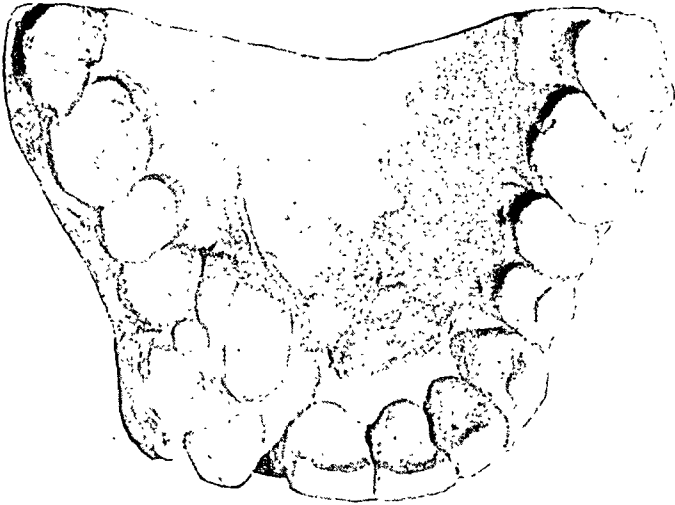


of course very extensive, but the blood was controlled by pressure. Repair was prompt and complete. It is now, six years since the operation and there has been no return.

d. *Epulis*.—From the present day view-point epulis appears to include any variety of growth of the alveolar process which takes the form of a distinct tumor. During the early stages, unless a section is examined microscopically to prove its histological structure, it would be difficult to say whether it is a hyperplasia, fibroma or a sarcoma. The age of the patient has little to do with the development, although the majority have been observed in young manhood.

The most recent authorities divide the so-called epulitic growths into myeloid and fibroid, the former being growth of a spongy nature with irregular surfaces. The tendency is to grow in every direction and in some instances to carry the teeth along, as will be observed in the case reported. The surface is warty and the color conforms quite nearly to the normal mucous membrane during early development;

FIG. 5.



Hypertrophy of the left upper alveolar tissue in a woman of forty-five.

FIG. 6.



A case similar to the foregoing, in a patient thirty-five years of age.

FIG. 8.



Typical fibroid epulis. The growth was removed down to and including the external half of the process.

FIG. 9.



Result of operation in case shown in Fig. 8.

later, however, the color becomes a darker red and in cases that become infective and suppurative, reparative patches of a lighter hue will be found over the red surface.

The second, or fibroid epulis, is most common upon the mandible. During the early stage it resembles the myeloid type, but soon assumes a plum or a maroon color. There is a tendency to grow from the buccal surface. There is also tendency to develop in concentric forms, as may be seen in Fig. 8 as well as in Grunwald's case in Von Bergmann.

The differences of opinion that exist as to their character are considered and one writer says that he has not found either a lipoma, dental aneurism or enchondroma in the number and that there is no evidence of its ever being epitheliomatous. He states, in opposition to several authorities quoted, that none were true fibromas—six, however, being partly myxomatous; but he confirms the view that sarcoma is the commonest form, this being typical myeloid in character.

Hutchinson made a microscopic study of a case of myeloid epulis typical of myeloid sarcoma, with giant-cells. Nodules of bone were observed in the slide. It had been said that these tumors did not ossify, but he found the reverse to be the case. The plum color of the tumor was very characteristic. A case of epithelial epulis in a woman, aged 58, and successfully treated by partial excision of maxilla, is reported by Malloch.

Diagnosis must be made from simple acute inflammatory diseases that run an acute course, from polypi that have smooth surfaces, from cysts, hypertrophies, exostoses of the process, and malignant disease of the bone. The myeloid variety, as a rule, has a warty appearance and grows outward in every direction from the process, carrying along with it a tooth, or many teeth if unmolested. The teeth rest in a jelly-like mass insecurely and may easily be extracted. The surface when irritated bleeds readily, and sometimes alarmingly. In a recent case in the author's practice, a small portion was removed for microscopic examination and the hemorrhage was so profuse as to require constant pressure for half an hour to control it.

Treatment.—The treatment consists in early and effectual removal. The teeth must not be considered, since the growth usually includes the process down to the roots as well as the periosteum and mucous membrane. The accompanying cases will furnish typical examples as well as outline the treatment with results. Treatment for the fibroid variety is to remove without destroying the bone to any considerable extent. Repair follows and there is no tendency to return.

Fig. 8 shows a typical fibroid epulis. The growth had a maroon color. A tooth appeared to be the irritant, or the teeth that were included in the growth were thought to be the cause and were removed by a dentist. The growth as shown developed in three months. It was principally from the buccal surface and had a concentric tendency. It was soft and spongy and only slightly roughened.

Operation consisted in the removal of the growth down to and including the external half of the process. One tooth back of the tumor was included and required removing. Repair was prompt, the patient remaining in the hospital but three days.

The result is shown in Fig. 9.

B. CHLOROMA.

Apropos of the report of a case of this rare disease, in the ANNALS OF SURGERY, January, 1910, the following case is reported in connection with the tumors of the alveolar processes.

The hypertrophy began in the gingival mucous membrane throughout both maxillary bones, and extended from these points uniformly in every direction (see Figs. 10 and 11).

Photos were taken six months after the onset. The patient lived one year after this. There was no bone involvement. Very little local infection or abscess formation developed. The metastasis extended down the neck, the glands being involved but the skin was not affected. The growth extended across the roof of the mouth, and the oral mucous membrane was universally hypertrophied, so that he could take only liquid foods for several months before death. X-ray treatment made no impression.

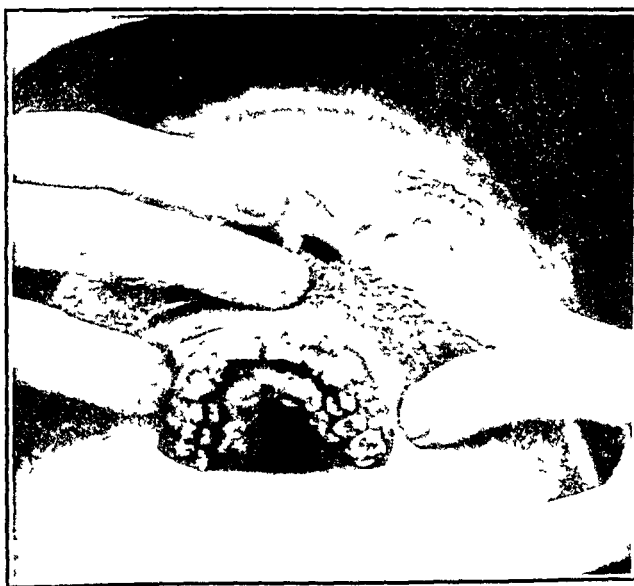
Microscopic examination did not show malignancy.

FIG 10.



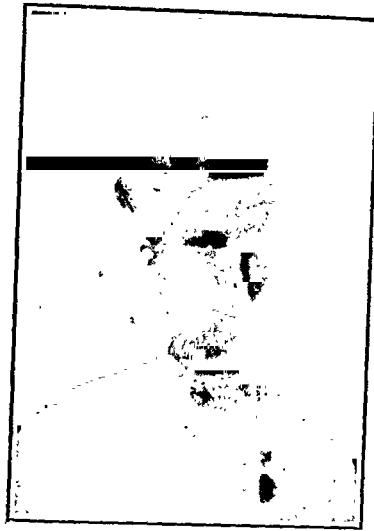
A case of chloroma—lower

FIG. 11.



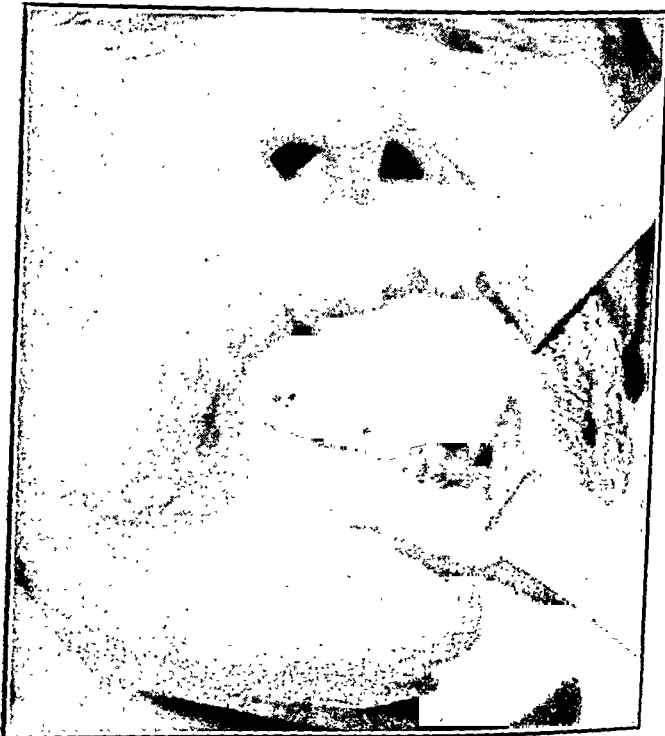
Upper.

FIG. 12.



Sarcoma developed from a case of necrosis following alveolar periostitis.

FIG. 13.



Epithelioma of the mandible.

C. BONE TUMORS AND CYSTS.

(a) Exostoses or osteophytes; (b) osteomata or hyperostoses; (c) cysts of bone.

a. *Exostoses* or osteophytes are small, round, bony growths arising in the periosteum and spreading laterally as a result of inflammatory or traumatic disturbance of this membrane and its attachment to the bone. They are products of the periosteum, just as it reproduces bone after necrosis. They are composed of branching trabeculae or sheaves filled in with cellular connective tissue or spongy formation. They have no clinical significance, do not cause death, and should be removed only when making pressure on other structures or their size demands an operation. Endosteomata are the same except that the growth is from the endosteum in the centre of bone. They have no clinical significance here. Exostoses of the accessory sinuses of the face are not uncommon. In the anterior or frontal sinuses they grow to enormous size. The growth is outward. They require removal when their size produces deformity. They are benign.

b. *Osteoma* or hyperostosis is a diffused new formation of bone or a growth including the bone in general and not circumscribed as in exostosis. The entire bone structure is involved. The growth, while occasionally circumscribed, is usually diffused, including a hyperplastic change of the cancellous and compact structure uniformly. It is found everywhere in the skeleton. A form is seen in the alveolar process, where it is usually diffused and the entire process is involved, but occasionally it is localized. An assignable cause (*i.e.*, a specified irritant) is not always obtainable. Leontiasis ossea is a typical disease of this variety.

c. *Cyst of Bone*.—A tumor beginning as a small enlargement of the alveolus usually upon the external surface. As a rule there is no pain or other inflammatory symptom. The growth is gradual, extending over a period of many months or years. The tumor is uniform, margins well defined. The mucous membrane over the surface is normal as a rule and

only becomes red when infection and pus formation occurs. The tumor may develop years after teeth have been removed and run the same course as other bone cysts.

Pathology.—The bone gradually melts away and the space is occupied by a fluid formation. The bone around the margin is usually elevated, due to the tendency of the periosteum that is left after the bone destruction to reproduce bone. The elevated margin recedes, however, as the cyst encroaches upon new bone. The external margin is denuded in the direction of the extension only, the remaining wall being well defined and composed of well-organized granulation tissues.

Operation requires free incision, removal of denuded bone, curettement of such portion of the cyst wall as appears incapable of repair. The cavity should be cleansed with pure alcohol, and only moderately packed, to control hemorrhage; subsequent packing should be to prevent the entrance of food only. The walls should be permitted to collapse so that the cavity may be obliterated as early as possible. The orifice should be kept open with packing until the deeper portion of the cavity has healed. Repair without complication or return may be usually expected.

An unusual tumor developed in the roof of the mouth, in a woman aged 30 years. It first appeared about the centre of the median line. It had been growing about two years when she asked for an operation. At that time the left nasal cavity and all but the upper part of the right was obstructed. The tumor projected downward flush with the teeth and filled the vault of the mouth.

D. MALIGNANT TUMORS.

a. *Sarcoma* presents the most formidable and rapidly growing of all tumors involving the alveolar process. Recent investigations show that sarcoma is the result of trauma, as an injury from extractions or contusions or blows. Apparently simple conditions about the teeth requiring operations

may be followed by sarcoma. The growth is uniform, the course rapid, in a few weeks becoming many times the size of the bone itself. When involving the mandible it rapidly involves the skin, which breaks down, and as mixed infection occurs the discharge becomes profuse and offensive. Further skin and soft tissue are involved. The glands toward the clavicle are enlarged and become suppurative during later stages.

Symptoms.—It usually occurs in young manhood from fifteen to twenty-five years. The growth is rapid and painful. Temperature from 99 to 101 degrees is usually found before suppuration and higher after systemic toxæmia from absorption following suppuration.

Diagnosis.—It must be differentiated from the various forms of bone infection during the stages of sequestration. The bone may be cast off, resembling periostitis. Syphilitic gummata resemble sarcoma very much and the rapidity of the latter, along with the age (sarcoma in young manhood and syphilis at all ages), exostosis and osteoma are not usually confounded since they are characterized by a uniform, painless enlargement without suppuration. Carcinoma must also be excluded since the latter occurs in middle life and the growth is slow.

The case illustrated in Fig. 12 presented the usual symptoms of necrosis following alveolar periostitis, extending over a period of several months. No signs of growth were present. The sequestrum was removed and a favorable prognosis was made. The patient left the hospital in one week. Four weeks later she returned with an unmistakable sarcoma. Four weeks after this, the growth seen in Fig. 12 had developed. It was inoperable, since complete enucleation could not be promised. Under trypsin amylopsin treatment the development was checked. It remained latent during two months' treatment, when the patient withdrew, and at the end of another month it began to grow and she died in four months.

Treatment.—Early diagnosis and removal is most vital. When operation is not done it is best controlled with judi-

ciously administered X-ray treatment, followed by the removal of the tumor as soon as the rays have controlled the growth. Many cases are in this way cured and all are greatly benefited.

b. *Epithelioma* of the tissues overlying the maxilla and mandible develop as a result of some chronic irritant. Bad teeth are most frequent causes. A rough tooth constantly coming in contact with adjacent mucous membrane, or excessive tartar and spiculæ of bone in neglected mouths are fruitful causes. Papillomata, epulitic or other fibromata when cauterized frequently for their removal, as is too often practised by dentists, result in malignancy. Many cases of this character are reported.

Symptoms.—The growth is slow and not painful until it reaches considerable size. It is found in middle or advanced life. It involves neighboring lymphatics. The tumor as it is found in the mouth is irregular, warty, the normal mucous membrane entirely disappearing. Further extension includes the skin. Suppuration as a result of mixed infection with the usual constitutional symptoms must follow. It then becomes very painful.

Diagnosis must be made from sarcoma, gumma, periostitis, osteomyelitis and actinomycosis. Sarcoma involves the entire bone but the tendency is to enlarge outward. In carcinoma the growth extends under the tongue and in every direction uniformly.

Prognosis is toward a fatal end unless extirpation is done early and effectually.

Treatment now is enucleation followed with Röntgen rays for several months to destroy the cells in the deep structures, if any remain, and to prevent return in scar tissue.

In the case shown in Fig. 13 operation consisted in opening into the tumor by incision from before backwards. The contents were cheesy. The cavity was as large or larger than a hen's egg. Several roughened, bony points were found and curetted. Hemorrhage was quite free but easily controlled by packing. The nasal and antral cavities, while encroached upon, were not

entered, since the origin of the cystic material was from the oronasal partition and the membranous floor of the cavities was simply pushed in every direction by the gradual accumulation of this material. No complication occurred during recovery. The walls of the abnormal cavity, so widely extended, gradually collapsed and approximated. Only moderate packing was used. At the end of three months the cavity remained as a small sulcus communicating with the mouth and causing no inconvenience.

CYSTS AND TUMEFACTIONS FROM TEETH.

- A.* Impacted teeth.
- B.* Delayed eruption.
- C.* Cysts from the roots of developed teeth.
- D.* Cysts and tumors in connection with the teeth during their development.

A. IMPACTION OF THE TEETH.

Teeth occasionally fail to erupt. The process of budding may be in the wrong direction, and the tooth grows upwards or to one side, or some obstruction may interfere with the normal eruption, and instead of the crown pushing its way through the alveolus it grows in the opposite direction.

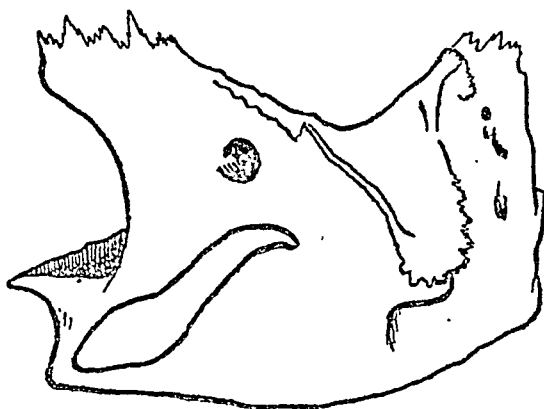
Discharging sinuses from the maxilla are not always evidence of disease of the antrum or other sinuses or of osteomyelitis or tubercular bone disease. These sinuses are not infrequently the result of an impacted tooth.

Indeed, all sinuses which give a chronic history associated with slight or possibly no pain when the sinus is opened, extending over a period of years, are more likely to be caused by non-eruption than destructive bone disease.

Mrs. A. T., aged forty-nine years, had suffered with pain in the right maxilla, just external to the ala, for 19 years. There had never been any discharge for 16 years, when a small opening which discharged small quantities of pus and serum was discovered internal to the second incisor. This has remained open for three years; occasionally it would close and be followed by pain which continued until spontaneous eruption relieved the suffering

(Fig. 14). An effort to determine whether it was a case of necrosis or impaction resulted in a decision of the latter for the following reasons: (1) In necrosis a greater amount of tissue would have been involved. (2) The character of discharge would have been pus at all times, usually of an offensive odor. (3) The patient was uncertain as to the eruption or extraction of the second incisor. (4) In osteomyelitis or tubercular bone disease a sinus would have formed long before it appeared in this case. (5) Associated symptoms, as swelling, involvement of secondary structures, as the antrum, would have resulted; none of which was ever present. (6) The general health of the patient would have been impaired.

FIG. 14.



An operation under general anaesthesia consisted in enlarging the opening in the mucous membrane along the line of the alveolus. As the sinus in the bone was slightly back of the alveolus, the bone was cut inward with a chisel. After excavating the opening sufficiently to admit a pair of bone forceps, they were entered with some difficulty, and a tooth was dislodged from its abnormal location. The depth of the cavity thus left after the removal of the tooth was two inches, as determined by actual measurement.

The subsequent history showed that no foreign substance had been allowed to remain, and the sinus was entirely closed in a week and has remained so and free from pain for four years.

Two cases very similar to the foregoing are appended.

Mrs. S., aged fifty-four years, had had her teeth extracted when thirty-five years old and had worn a full upper vulcanite

plate for 15 years with perfect comfort. After wearing a new plate for several weeks she returned to the dentist and accused him of making the suction cavity too large, dead bone resulting in the roof of her mouth. A careful examination revealed the existence of a tooth slightly to the centre of the oral vault. There was a very small sinus; the orifice was not granular as it would have been were dead bone present, and there was but slight discharge. A probe came in contact with a smooth hard substance characteristic of a tooth. An operation was advised and accepted. A canine was removed perfectly developed. The wound promptly repaired, and a malpractice suit was averted (Fig. 15).

Another case was that of a woman aged twenty-four years who had been wearing a full upper plate for about two years. A sinus was discovered in the roof of her mouth slightly to the left. A

FIG. 15.

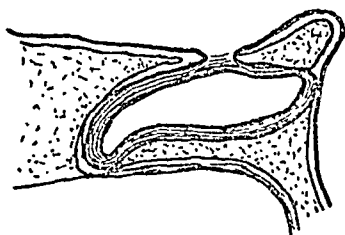
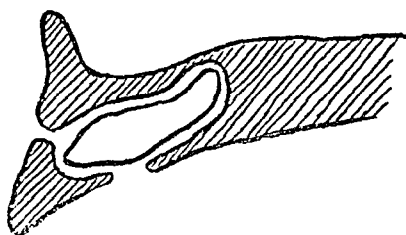


FIG. 16.



second sinus opened on the labial aspect of the alveolus. Upon introduction of a probe it came in contact with a tooth. Under somnoform anæsthetic it was removed. Repair followed without complication, and so little change occurred that the plate used before the operation fitted perfectly afterward (Fig. 16).

An interesting case of multiple malposition with cysts evidently becoming suppurative is that of a young man of twenty years who had had discharging sinuses and tumefactions of the right maxilla for eight years. A sinus led into the right cuspid and another into the right upper molar with other sinuses extending back of the maxillary bone on both sides well into the zygomatic fossæ. The patient had had two operations, one for mastoids and the other for necrosis, but in neither instance were the impacted teeth found (Figs. 17 and 18).

Operation included the removal of the impacted teeth with curettement, and repair followed in the course of a few weeks with no further symptoms from the maxilla. The patient returned

in three months with an enlargement over the lower left second bicuspid. This tooth had not erupted. An operation was performed and this tooth, imbedded in cystic material, fully developed, was removed after chiselling away sufficient of the external table.

The patient returned when he was twenty-seven years old with tumefactions on the external surface of both angles of the maxilla. These enlargements were the size of a silver quarter and at least half an inch outward from the bone. With the knowledge that neither one of the lower third molars had erupted and with the experience that had been furnished from the other teeth, diagnosis of cysts developing from the impactions was readily made out. Operation was performed and the teeth were removed.

The cysts had become suppurative and offensive and required irrigation for about three weeks. The cavities, which were quite large, finally collapsed and were entirely obliterated (Fig. 19).

Miss B., aged twenty, had been suffering pain in the region of the superior molars since her twelfth year. She knew that her twelfth-year molars had not erupted and was of the opinion that they had something to do with her suffering. This appeared to be quite evident.

Operation was advised, and under chloroform an incision was made from the first molar backward along the crest of the alveolus. The incision was extended down to the bone. The soft tissues, including periosteum and mucous membrane, were dissected back from the alveolar ridge so as to permit freedom in further operation. The tooth was found partially covered with bone. This was chiselled away and the tooth was pried from its position with a bone elevator. The crown of the tooth pointed directly forward and rested against the first molar (Fig. 21). The roots projected slightly downward parallel with the long axis of the alveolus.

The operation on the other side was exactly the same, the tooth was found in the same position. The flaps were adjusted and secured with catgut sutures. Repair followed without complication.

The case is unusual because of the bilateral condition, the teeth on both sides being in the same position.

FIG. 18.

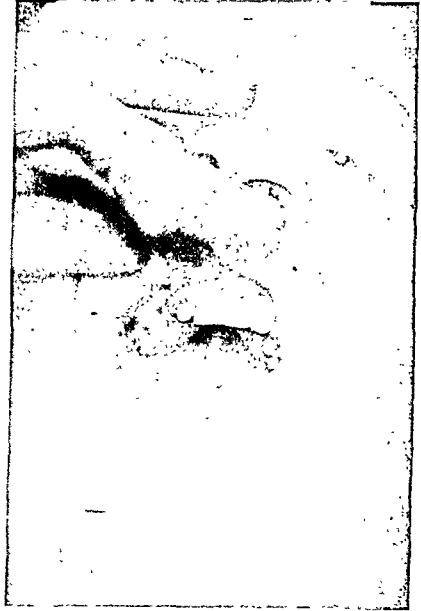
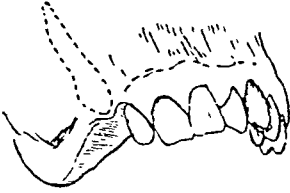


FIG. 17.



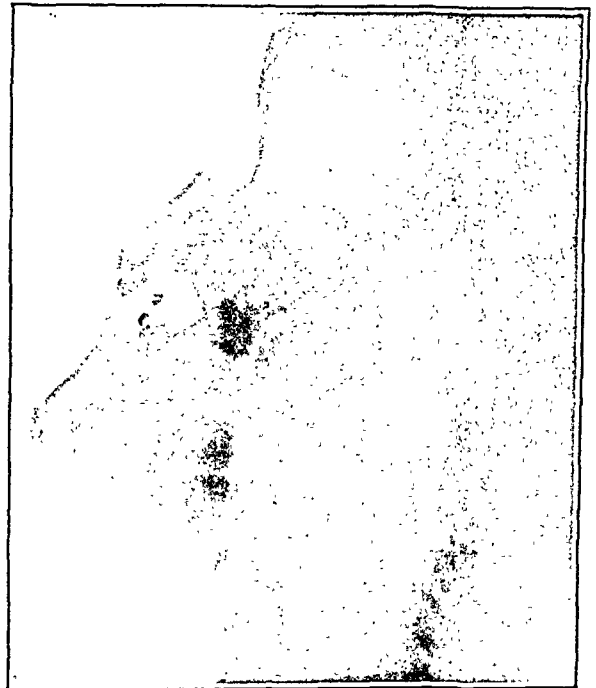
Multiple malposition with cysts becoming suppurative.

FIG. 19.



Cyst of mandible.

FIG. 20.



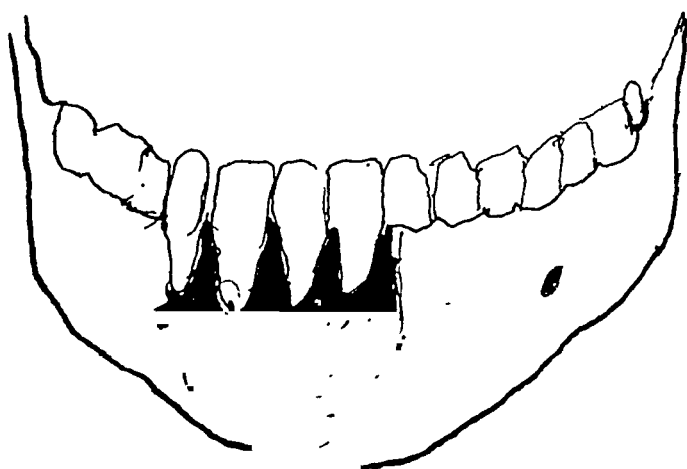
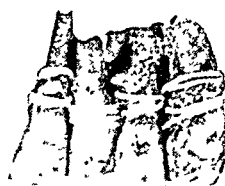
Cyst of mandible from two impacted teeth at right angles to each other.

FIG. 22.



Cyst from delayed eruption.

FIGS. 23 AND 24.



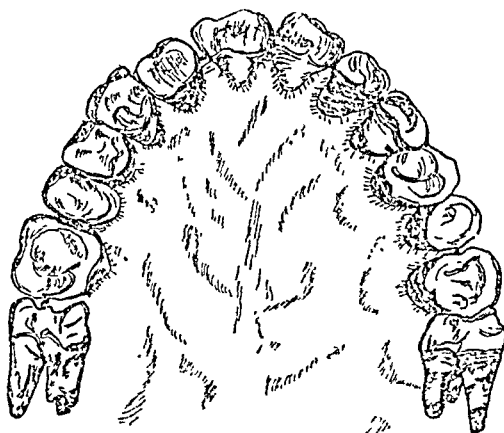
Cyst from the roots of developed teeth.

B. CYSTS FROM DELAYED ERUPTION.

The teeth do not always erupt at the usual time, because of some obstruction at the point of usual exit or because of cystic or perverted development. In some instances the development is outward and an enlargement is formed, in some cases so large as to attract the attention of the dentist, who, if he does not suspect the real condition, will send the patient to a surgeon and an operation is too often performed.

The principal diagnostic point is the absence of the tooth, when it should have erupted. While there is some discomfort—even more than is usual with ordinary eruption—the pain

FIG. 21.



is never very severe. There may be nervousness, slight fever, loss of appetite, but all symptoms are mild. No operation should be done unless the delay extends over several months, or special reasons exist for surgical interference, such as supuration, unusually large tumor, etc. If left undisturbed they will make their own way through the usual canal.

A case in point is that of a girl ten years old, who had been examined by dentists and doctors for a tumor over the root of the left lower cuspid (Fig. 22). It was half an inch in circumference and almost as high, and gradually increasing in size. Further examination revealed the same condition just beginning on the opposite side at the same point. During the course of the next six weeks, the cuspids above showed the same tendency toward development outwards.

Treatment.—It is proper to permit the teeth to develop uninterrupted until they erupt, and when not in proper position the orthodontist will be able to correct defects and deformities.

C. CYSTS FROM ROOTS OF DEVELOPED TEETH.

A second and more common form develop from the roots of teeth after eruption. One or several teeth may be included. The roots of the teeth involved melt away, thus destroying the blood and nerve supply. The growth is usually upon the external surface only, because there is less resistance in this direction. They are doubtless caused by periostitis of the roots. The inflammatory process is of a low grade and seldom becomes an active suppurative condition. The fluid is turbid. The cavity is quite distinctly outlined. The apices of the teeth extend into the open cavity and are denuded back to the bony wall. When they develop in the maxilla adjacent to the antral floor this cavity is usually involved. In some cases they become suppurative and a diagnosis is more difficult.

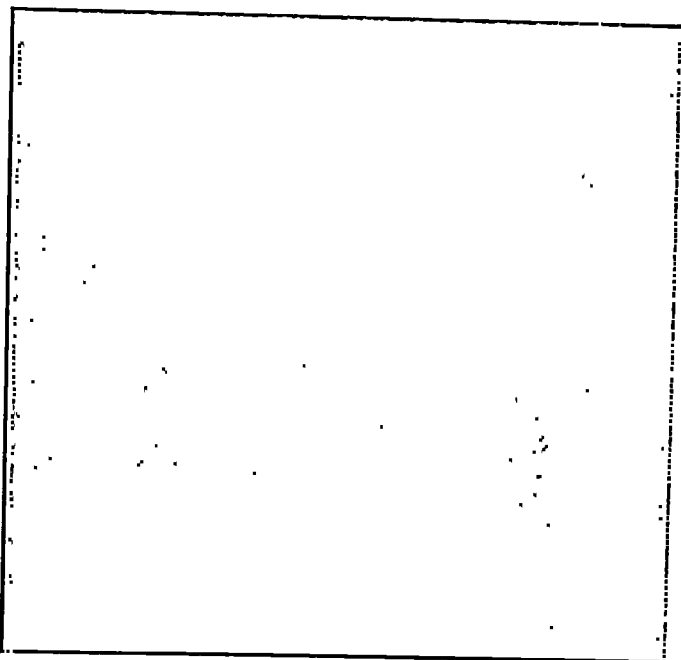
The case shown in Figures 23 and 24 was a woman about thirty-five years of age. The lump had been growing gradually for more than two years. The cavity contained a thick straw-colored liquid with some shreds. The wall was well defined but irregular. The roots of the teeth stood out into the cavity, imbedded in the fluid. They were denuded back to the bone and the entire external table was destroyed to the gingival margin. The apices were gone, thus destroying the blood and nerve supply.

Treatment.—The operation was done through the mouth, and consisted in making an incision down through the centre of the tumor, evacuating the contents of the cyst. The teeth were removed without difficulty. Such portions of bone as were thought to be dead were removed. The subsequent history was uneventful; repair followed rapidly.

D. CYSTS AND TUMORS IN CONNECTION WITH THE TEETH DURING THEIR DEVELOPMENT.

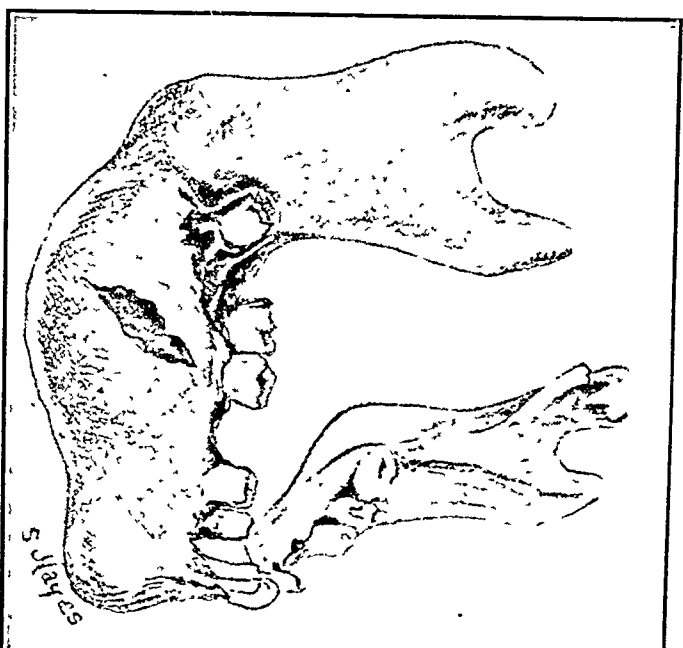
Developmental Tumors.—Neoplasms that have as their cause some portion of the teeth during embryonic develop-

FIG. 25.



Colored girl, nineteen years of age. Tumor of thirteen years' duration in connection with teeth during their development. Complete resection was performed. Patient died at end of the third week from abscess of the lung. (Bloodgood.)

FIG. 26.



Reconstructed lower jaw in a case of dentigerous cyst. The expansion of the body, chiefly on the outer side, is well shown and the recess containing the non-erupted wisdom tooth. (Bloodgood.)

ment are not uncommon. The literature is not extensive and the classification given by Bland-Sutton twenty years ago has not been changed.

They are tumors originating from one or more of the dental tissues of the tooth germ during the process of development. They differ from impaction in that the tooth does not develop properly and some portion of the histological structure is the nucleus and enters into the formation of new growth. They also differ from those having their origin about the roots of matured teeth.

The following summary of odontomata is taken from Bloodgood:

In his analysis of ten cases: upper jaw, 4 cases; lower jaw, 4 cases; ethmoid, 2 cases. The ages of the patients varied from 6 to 30 years, 4 were under 15 years of age, 6 between 20 and 30. The duration of the tumor varied from three months to thirteen years.

Etiology.—Writers have not agreed as to the real cause of tooth cysts. Sutton says: "Histologically, an epithelial odontoma consists of branching and anastomosing columns of epithelium, portions of which form alveoli, the cells occupying the alveoli varying, the outer layer being columnar, while the central cells degenerate and give rise to a tissue resembling the stratum intermedium of an enamel organ. They probably arise from persistent portions of the epithelium of enamel organs."

Sutton's classifications of developmental neoplasms of the teeth are as follows:

Odontomata: (1) epithelial (enamel organ); (2) follicular (fibrous, cementous; compound); (3) radicular (from the root); (4) composite (from the whole germ).

1. *Enamel organ* tumors are developed from the epithelial cysts—usually multilocular—filled with mucus and having a red circumferential area resembling sarcoma. They develop from 18 to 23 years of age generally, but may appear at any age. Their origin is probably from persistent remains of epithelium of the original enamel organ.

2. *Follicular Odontomata*.—These tooth tumors, according to Sutton, appear in three forms. Unless the successive stages are studied microscopically, the follicular and fibrous forms and the composite variety present very much the same characteristics. They are typical of the so-called dentigerous cysts.

They develop from the permanent teeth, usually the molars. The wall is formed by the expanded tooth follicle, which is filled with a viscid fluid and in which is found the imperfectly developed, loose, and displaced tooth. They may grow to enormous size, causing great deformity. This variety is known as *fibrous*. The cyst wall usually calcifies. The cementum of the tooth, *i.e.*, structure which gives origin to the cementum of the tooth, had to do with the calcareous change above mentioned, hence the name sometimes used, *cementoma*. Two or more tooth follicles join in the process, when it is known as *compound* follicular odontoma. Dozens of these tooth-like bodies have been removed from such a cavity. They rarely, if ever, suppurate.

Bloodgood says: "Under the microscope one sees the normal mucous membrane of the gum, then a zone of connective tissue, beneath which is the circumscribed tumor. The tumor is composed of branching epithelial alveoli in a connective tissue stroma. Some of the alveoli are cysts lined by the typical basal adamantine epithelium. Other alveoli are solid with cells showing the various morphologic changes of the adamantine epithelium."

Cementous Follicular Odontoma.—Referring to the above classification certain tumors take upon themselves the consistency of a tooth and may be a simple budding from the side of a tooth, from the root, or the crown, or the cementous growth may include the entire tooth, leaving only one place on the crown projecting to identify it with the particular tooth.

3. *Radicular odontoma* differs from the former in that the crown of the tooth does not enter into the diverted process, as it is composed of unalterable enamel. The dentine and cementum enter into the formation in varying proportions. The tooth erupts, but loses its identity in the tumor which is

attached to the base. It is rare, and seen more frequently in the lower animals.

4. *Composite odontoma* comprises a combination of two or all of the tissues of the teeth, as the cementum, enamel, and dentine may be involved. The normal tooth structures are entirely displaced by the new process. In other regards they do not differ from the first three varieties.

Symptoms.—The symptoms are tumefaction, beginning as a rule from the side of the alveolar process, increasing outward uniformly in all directions, or if they develop from a buccal root the enlargement will be inward. The growth is not rapid, requiring many months to produce much deformity, but as it is progressive there is no limit to deformity if left unoperated. Pain may be severe and is caused by the pressure upon the normal nerve terminals and surrounding structures. There are no constitutional symptoms from the tumor *per se*, and when present the result is involvement of adjacent vital tissues.

Diagnosis.—Broca says, "That any new growth of the jaw which occurs after complete development of the teeth is certainly not odontoma."

The diagnosis is very important, since odontoma is frequently considered malignant and the entire maxilla and half of the mandible have been removed, because malignancy was diagnosed when a postoperative dissection revealed an odontoma. No tumor beginning in the alveolus should be removed until odontoma is excluded. This may be done by passing a sterile needle or awl into the tumor at several points, or an exploration incision may be made and the central structure examined. The incision should be made in view of the radical operation in case malignancy is found. Having this in mind, useless sacrifice of tissue is prevented. Firm pressure upon some of these tumors reveals a parchment-like crackling.

A most frequent mistake of the general surgeon, who is on the lookout for sarcoma, osteoma, etc., and seldom sees a dentigerous cyst or a tumor due to noneruption, is to confuse the graver condition with the latter. In this event he makes a complete removal of a maxilla or half of the mandible.

After the operation is completed and the tumor incised a tooth is found in the centre. Had the true condition been suspected it would have been removed, and such abnormal process of the bone as was found chiselled away, the cavity curetted, and in a few weeks repair would have followed without deformity or destruction of functional usefulness of the parts.

Differential diagnosis must be made from the teeth and bone cysts, osteoma, exostosis, sarcoma, carcinoma, actinomycosis, and the swellings associated with chronic bone diseases as osteomyelitis, syphilitic gumma, and tuberculosis.

Treatment.—The treatment of the simple variety is, according to Hektoen, obviously plain and efficacious, namely, to incise the cyst as early and as thoroughly as possible, remove the impacted rudimentary or full grown tooth, scrape away the epithelial lining and pack the cavity with suitable material. In some instances it may be necessary to remove part of the jaw and of the cyst wall in order to gain access to the cavity. Many surgeons advise that such operations be made as often as possible from within the mouth. While surgeons have erred in making too aggressive operations in case of simple dentigerous cyst, error has also been committed in treating proliferating cystomata ineffectively, thus subjecting the patient to many operations, each with its risk, when one correctly performed operation would have been sufficient.

As already indicated, the surgeon should regard the incision into a supposed simple cyst as exploratory, because a differential diagnosis between a simple and a proliferating cyst, particularly in the early period of growth, cannot be made without direct inspection; and the surgeon should also prepare the patient, and be prepared himself, for the more severe operation, in case the growth should be a multilocular one. In fact, it would seem to be a good plan, as suggested by McLane Tiffany, in all cases of operation upon tumors of the maxillæ, to incise the tumor first in order to be absolutely certain that mistake in diagnosis may not result in an unnecessarily severe and disfiguring operation.

FRACTURE OF THE HEAD AND NECK OF THE RADIUS.*

BY ROLAND HAMMOND, M.D.,

OF PROVIDENCE, R. I.

PREVIOUS to the discovery of the Röntgen ray this fracture was practically unknown, or was discovered only in anatomical dissections; it was regarded as a surgical curiosity. The first case was reported in 1834, as the result of a post-mortem examination. Up to 1880 but 21 cases were known, and of these 20 were discovered only after operation or dissection. As late as 1905, four years ago, the literature contained but 48 cases, only 8 of which had been recognized by clinical signs during life. At this time, four Röntgenologists in Philadelphia found 55 cases in their collections of plates, which exceeded the total number recorded at that period.

The literature of the subject has been thoroughly reviewed, and some excellent experimental work on the mode of production of this fracture has been done by T. Turner Thomas,¹ whose writings have placed this subject on a sound scientific basis.

The ever increasing use of the Röntgen ray in fracture work has revolutionized our knowledge of this subject. We are enabled to make a more accurate diagnosis, and with the knowledge thus gained to make a more careful reduction of the fragments without resorting to aimless and often harmful manipulation. We can then verify our results to ascertain whether the reduction has been properly accomplished. All this is well recognized.

But we owe a further debt to the Röntgen ray. Many fractures hitherto unknown, and formerly treated as sprains, have been brought to light, and many fractures thought to be rare are now known to be fairly common. Many frac-

* Read before the Providence Medical Association, June 6, 1909.

tures, from their obscure position or from the nature of their surroundings, give none of the well-recognized signs which we have learned to associate with a broken bone. Crepitus, abnormal mobility and impaired function are often absent, and pain may be the sole symptom to guide us in reaching a correct diagnosis. So it is with fractures of the head of the radius, and usually this condition is unsuspected until revealed by the X-ray plate. Its importance has been underestimated as well, for, on its recognition and proper treatment may depend the integrity and usefulness of two of the most important joints in the body—the elbow and wrist.

Anatomy.—The orbicular ligament and the lesser sigmoid cavity of the ulna form a sling in which the head of the radius rotates easily through nearly half a circle. Any injury at this point interferes with the important movements of pronation and supination, and, from its intimate relation with the elbow-joint, limits flexion and extension as well.

A fall on the hand is the most frequent cause of fracture of the radius at some point. Whether this occur at the wrist, in some part of the shaft, or at the head or neck of the bone depends on many factors. Turner has shown that the more nearly vertical the forearm at the time of the fall, the more likely is the force of the blow to be expended at the upper part of the bone, since in this position there is less cross-breaking strain. The tension of the muscles at the time of fall and the degree of rotation of the forearm also have an influence in determining the point of fracture.

Diagnosis.—As I mentioned above, the symptoms are deceptive. Pain is the only one I have found constant. Crepitus may be obtained in favorable cases on rotating the forearm, and this is the movement which usually gives most pain. Flexion and extension are ordinarily performed with less discomfort, but these movements may be painful. A point of localized tenderness is usually found over the head or neck of the bone. The diagnosis is made quickly and without pain to the patient by the Röntgen method, and this agent should always be employed. The objection of some writers

that this fracture is not shown, or is sometimes overlooked, by the X-ray, I have not found borne out by experience, if the pictures have been correctly taken. Oftentimes the antero-posterior and lateral views of the elbow-joint as ordinarily made are not sufficient to show this fracture clearly. Dr. Frank E. Peckham and the writer have devised an apparatus by which the head of the radius is brought in close contact with the photographic plate. This view, in connection with the ordinary anteroposterior and lateral positions, allows the bone to be viewed from all sides. By this X-ray study of the elbow the fracture is shown if present. In one of the cases given below, the views, as ordinarily taken, failed to show the fracture, until this procedure was employed.

The fracture may be of the fissure type, in a vertical direction through the head or neck, the fragment often being wedge-shaped, or the head may be impacted. In both of these types the fragment is usually in good position. There may be enough displacement to interfere with flexion as well as rotation. When the fracture occurs in the neck of the bone, the upper fragment is more likely to be displaced downward and outward, and can often be palpated. In these cases the disability is greater and the symptoms more pronounced. The head is often split into several fragments, one or more of which will be displaced, often to some distance, and may interfere with complete flexion of the elbow. This fracture is often overlooked, in the absence of the well-marked signs which accompany the more easily recognized fractures, and treated for a sprain or contusion. In these cases free use of the joint, which is often encouraged, may lead to permanent disability of the joint to some extent, or possibly to non-union of the fragment.

Prognosis.—This is good in the small class of cases where there is a vertical fissure through the head and oftentimes in the impacted cases. The fragments are held firmly by the orbicular ligament, which prevents displacement and encourages firm bony union. With comminution and separation of fragments, however, the chances of obtaining a perfectly use-

ful elbow are not so favorable. The extrusion of bone into the joint cavity and the formation of callus may interfere with flexion and extension as well as with rotation, and the patient should be warned of this possibility.

Treatment.—In cases with good approximation of fragments and but slight displacement, I have had the best results with the right-angled tin splint fashioned for the individual arm and supported by a sling. The splint should be left in place for several days to a week. It is then removed at intervals of two or three days and massage and gentle passive movements begun. These manipulations should be under the care of the physician, and great pains must be taken not to displace the fragments by injudicious movements, as has happened in the hands of an unskilled masseur. By the end of the third or the beginning of the fourth week the splint may be omitted and the arm carried in a sling for another week. At the end of this time all apparatus may usually be omitted. This early joint movement, when used with due care, will tend to preserve the mobility of the joint and prevent the formation of the firm adhesions and ankylosis which are the bane of fracture work. If the motion is begun early and continued with caution and regularity, it will be found, on omitting the splint, that the joint is much more useful than when continuous fixation has been employed. Most writers speak of limitation of motion as almost invariably present on removing the splints. This partial ankylosis may be eliminated in many cases if due care in treatment is exercised.

Where there is marked displacement of fragments which encroach upon the joint cavity, there will naturally be some ankylosis no matter what the treatment, and the question of operative interference arises. Each case must be judged on its own merits as shown by the Röntgen examination, but the best results will usually be obtained where a conservative method of treatment has been followed, leaving the open operation for those cases of displaced fragment with limited motion in the joint, or the rare cases of non-union. If the

plate show a fragment so greatly displaced, that, if left in position it will result in partial ankylosis, or is in danger of becoming a foreign body through non-union, it had best be removed at once by operation.

Bardenheuer² states that he has never found it necessary to operate on a case of this fracture.

As an aid in the after-treatment of these fractures, baking in the hot-air oven will be found of the greatest value in affording relief from pain and in restoring motion to the joint, and massage and passive motion are much more effective after such treatment.

In looking over our collection of plates, I find 11 cases* of fracture of the head and neck of the radius out of 224 cases of all fractures taken during the past three years. Of these 11 cases, five were referred for X-ray examination within a few days of the injury, and in no case was the condition accurately diagnosed until the X-ray plate had been taken. Four of the remaining cases were seen from three to seven months after the injury, and came for relief of pain or in hopes of obtaining a more useful elbow. In none of these cases, nor in the two which I have treated personally, was the diagnosis made until the Röntgen examination had been made. The cases that I have been permitted to see in the practice of other physicians have been very instructive. I believe the condition is a difficult one to diagnose, and in most cases impossible without the aid of the X-ray.

I have treated two cases of this fracture, both of the head of the radius. The first case occurred in the practice of Dr. Frank E. Peckham, and was treated by me during his absence. I am indebted to Dr. Peckham for the privilege of reporting this case.

CASE I.—A young clergyman came to the office with an injury to the right elbow, of six days' standing. He had been thrown from his horse while riding. Pain was distinctly local-

* Since writing this paper three other cases of this fracture have been seen out of a total of 344 cases of all fractures.

ized at the head of the radius, most marked on rotation of the forearm, and to a lesser extent on flexion and extension. The X-ray examination (Fig. 1) showed a wedge-shaped vertical fracture of the head of the radius with slight displacement at the upper end. A right-angled tin splint was fitted and worn for three and a half weeks. The splint was left in position for a week, and was then removed every other day for two weeks, and then twice a week until finally omitted. At each visit the elbow was moved gently but as much as possible in all directions. On finally omitting the splint there was perfect function in the elbow in pronation and supination as well as in flexion and extension, and no pain was experienced.

CASE II.—A physician, æt. 61, came to me for treatment of an injury to the left elbow. Five days previously, while coming out of his house, he had fallen on some stone steps, striking, he thinks, on his elbow. There was marked tenderness about the head of the radius, and motion was decidedly limited in all directions. The Röntgen examination made in the usual anteroposterior and lateral positions failed to show any fracture. This case resembled the first one so strongly, however, that I was convinced that some fracture was present, and the symptoms all pointed to the head of the radius as the most probable location. Accordingly, I placed the head of the radius in close contact with the photographic plate, and demonstrated a vertical fissure in the head with practically no displacement. The treatment was the same as far as splinting and manipulation were concerned, as in the preceding case. This injury occurred in sultry weather, and the patient suffered much pain. The splint was irritating and required frequent adjustment. On omitting the splint there was considerable pain, and some limitation in flexion and extension. The elbow was baked in a hot-air oven for four to five weeks, and at the end of this time complete function had returned, and pain was much less noticeable. The latter symptom was present to a slight extent for six months, but since that time, nearly two years since the fracture, the elbow has given no inconvenience whatever.

I have also had the opportunity of making a Röntgen examination in 12 other cases of this fracture occurring in the practice of other physicians. I wish to thank these gentle-

FIG. 1.



Vertical fracture of the head of the radius. Case I.

FIG. 2.



Impacted fracture of the head of the radius. Case VII. Patient of Dr. J. W. Keefe.

ized at the head of the radius, most marked on rotation of the forearm, and to a lesser extent on flexion and extension. The X-ray examination (Fig. 1) showed a wedge-shaped vertical fracture of the head of the radius with slight displacement at the upper end. A right-angled tin splint was fitted and worn for three and a half weeks. The splint was left in position for a week, and was then removed every other day for two weeks, and then twice a week until finally omitted. At each visit the elbow was moved gently but as much as possible in all directions. On finally omitting the splint there was perfect function in the elbow in pronation and supination as well as in flexion and extension, and no pain was experienced.

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I have also had the opportunity of making a Röntgen examination in 12 other cases of this fracture occurring in the practice of other physicians. I wish to thank these gentle-

men for the courtesy of allowing me to describe briefly these fractures from a radiographic standpoint, and to add them to the scanty literature of the subject.

CASE III.—Female (patient of Dr. E. E. Moore). Right elbow. Oblique fracture of the head of the radius down through the neck, with splitting off and slight separation of fragment. Complicated by backward dislocation of the elbow which had been previously reduced.

CASE IV.—Female (Orthopedic Department, Rhode Island Hospital). Left elbow. Oblique fracture of head and neck of radius, with separation outward and forward of a fragment half the size of the head.

CASE V.—Female (patient of Dr. E. S. Allen). Right elbow. Slight separation of fragment involving about one-third of articular surface of radius, and vertical fissure extending down into neck. Upper portion of neck is bent inwards.

CASE VI.—Female (patient of Dr. F. E. Peckham). Right elbow. Similar to Case V in size and displacement of large fragment, but also slight comminution of fragments in joint.

CASE VII.—Female (patient of Dr. J. W. Keefe). Left elbow. Impacted fracture of entire head of radius with displacement forward, inward and downward.

CASE VIII.—Male (patient of Dr. H. DeWolf). Left elbow. Oblique fissure fracture of outer third of head of radius with almost no displacement of fragment.

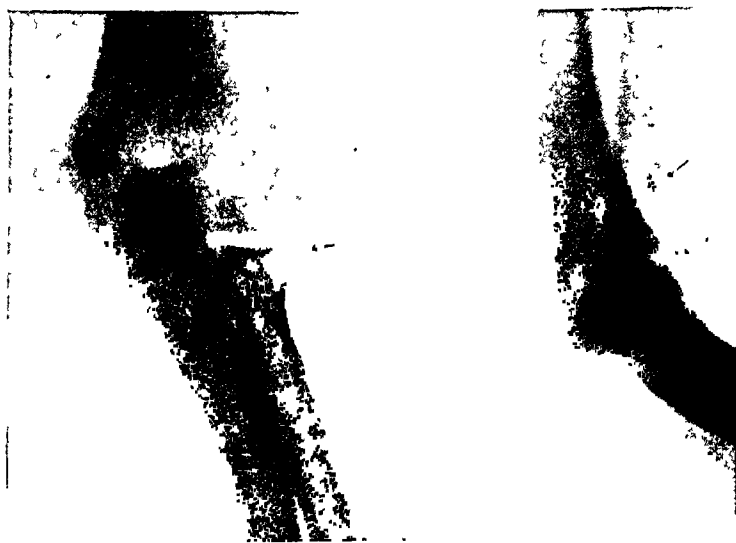
CASE IX.—Male (patient of Dr. F. A. Fearney). Right elbow. Fracture of outer half of head of radius with displacement of fragment upward into flexure of elbow.

CASE X.—Male (patient of Dr. W. R. Morse). Left elbow. Comminuted fracture of outer fourth of head of radius. Slight displacement of main fragment, but a small fragment displaced one-half inch upward into flexure of elbow.

CASE XI.—Male (patient of Dr. E. C. Murphy). Right elbow. Impacted fracture of head of radius with slight displacement forward and outward.

CASE XII.—Female (patient of Dr. F. E. Peckham) aged five. Right elbow. Fracture and dislocation of head and upper end of radius for one-fourth inch below the epiphyseal line, and displacement of fragment, including small part of shaft, downward and outward.

FIG. 3.



Comminuted fracture of the head of the radius with separation of fragment. Case XIV.

men for the courtesy of allowing me to describe briefly these fractures from a radiographic standpoint, and to add them to the scanty literature of the subject.

CASE III.—Female (patient of Dr. E. E. Moore). Right elbow. Oblique fracture of the head of the radius down through the neck, with splitting off and slight separation of fragment. Complicated by backward dislocation of the elbow which had been previously reduced.

CASE IV.—Female (Orthopedic Department, Rhode Island Hospital). Left elbow. Oblique fracture of head and neck of radius, with separation outward and forward of a fragment half the size of the head.

CASE V.—Female (patient of Dr. E. S. Allen). Right elbow. Slight separation of fragment involving about one-third of articular surface of radius, and vertical fissure extending down into neck. Upper portion of neck is bent inwards.

CASE VI.—Female (patient of Dr. F. E. Peckham). Right elbow. Similar to Case V in size and displacement of large fragment, but also *slight comminution of fragments in joint*.

CASE VII.—Female (patient of Dr. J. W. Keefe). Left elbow. Impacted fracture of entire head of radius with displacement forward, inward and downward.

CASE VIII.—Male (patient of Dr. H. DeWolf). Left elbow. Oblique fissure fracture of outer third of head of radius with almost no displacement of fragment.

CASE IX.—Male (patient of Dr. F. A. Fearney). Right elbow. Fracture of outer half of head of radius with displacement of fragment upward into flexure of elbow.

CASE X.—Male (patient of Dr. W. R. Morse). Left elbow. Comminuted fracture of outer fourth of head of radius. Slight displacement of main fragment, but a small fragment displaced one-half inch upward into flexure of elbow.

CASE XI.—Male (patient of Dr. E. C. Murphy). Right elbow. Impacted fracture of head of radius with slight displacement forward and outward.

CASE XII.—Female (patient of Dr. F. E. Peckham) aged five. Right elbow. Fracture and dislocation of head and upper end of radius for one-fourth inch below the epiphyseal line, and displacement of fragment, including small part of shaft, downward and outward.

CASE XIII.—Male (patient of Dr. F. E. Peckham). Right elbow. Oblique fracture of outer third of head of radius of the vertical fissure type. Slight displacement of fragment.

CASE XIV.—Male (patient of Dr. F. E. Peckham). Right elbow. Comminuted fracture of head of radius with separation of an irregularly shaped fragment upward into flexure of elbow.

The above cases were all adults with the exception of Case XII.

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BACKWARD DISLOCATION OF THE UPPER END OF THE ULNA.

OLD. COMPLETE DISLOCATION OF THE ULNA ALONE, WITH ROTATION AROUND
THE HEAD OF THE RADIUS. OPERATION: GOOD RESULT.

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BACKWARD dislocation of the upper end of the ulna alone, when complete, seems to be a rare lesion. Stimson, who gives an admirable classification of these injuries, describes three forms of dislocation of the upper end of the ulna.¹ The first form is that in which the displacement is slight; the ulna is carried backward and rotated slightly around the radius; and then, by adduction of the forearm or by upward movement of the ulna, the coronoid process passes behind the trochlea. In the second form, the coronoid process passes upward until it engages in the olecranon fossa. This requires that there shall be still more adduction of the forearm than takes place in the first variety. In the third form the rotation of the ulna around the radius continues until the ulna lies behind the radius.

Concerning the first form, it is the most common, and is spoken of as "incomplete." Stimson has been able to find only two recorded cases of the second form (the cases of Maligne and Wilson). I have not been able to find in literature a report or a description of any cases of the third form. The case herewith reported is such a one.

K.K., male, aged thirteen, jumped and fell from a wagon, striking upon his hand, forearm, and elbow. He suffered much pain; was unable to sleep for two nights; deformity of the elbow was recognized, and soon was obscured by swelling. He was not seen by a surgeon, but was treated with liniment. The elbow was stiff and painful. He was not able to use the arm. Gradually the swelling subsided. Pain was always present when the elbow

¹ Fractures and Dislocations.

was much moved. He was otherwise well. Nine weeks later the boy was taken to Dr. E. W. Skelton, who recognized the nature of the lesion and sent him to me at the German Hospital.

Examination showed the right ulna entirely absent from the trochlear surface. The radius was in its normal place. The upper end of the ulna could be felt lying posterior to the radius. External to the ulna, and connected with the outer condyle of the humerus, could be felt an irregular bony mass which was interpreted as the callus of a fracture of the condyle which had united in malposition. The forearm was in a position of flexion at an obtuse angle of about 150 degrees. Flexion and extension were possible through an arc of about 10 degrees. Supination and pronation were possible through only about one-fourth of their normal excursion. All of these movements were painful as they approached their limits. There was no œdematous swelling. The arm had undergone considerable atrophy. The X-ray plates showed the above-described conditions (Fig. 1).

Operation, ten weeks after injury: A long incision was made directly posterior to the displaced ulnar head. The ulna was found rotated just 90 degrees, so that the sigmoid notch instead of looking forward looked inward. The notch and the trochlear surface were covered with new connective tissue and adherent capsule. The connective tissue was dissected away from the articular surfaces; but when everything was freely cleared, it was impossible to rotate the ulna into place. Attention was then directed to the bony mass connected with the outer condyle. It was found that there had been no fracture as was surmised, but that the mass was an exostosis of new bone which had been thrown out beneath the stripped-up periosteum in front of the condyle. When this exostosis was chiselled off, the ulna rotated back into normal position with perfect ease. The wound was closed, and the arm was put up at a right angle in plaster of Paris.

At the end of two weeks, passive motion was begun; and at the end of three weeks the patient was allowed to use his arm. Motion of the joint steadily improved. There was no pain. At the end of two months the elbow functionated well excepting that flexion and extension stopped short of normal. The arm was

at this time the arm is normal in both its anatomy excepting that extension and flexion cannot be to full extent.

FIG. 1.



Outward dislocation of upper end of ulna. The upper end of the ulna is dislocated posterior to the head of the radius, and at the same time is rotated 90 degrees, so that the sigmoid notch and the coronoid process look inwards.



AUTOPLASTIC TRANSPLANTATION OF BONE.

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THE conditions which make it desirable to replace bony defects are by no means of rare occurrence. Chief among them are deficiencies of the cranial bones, of the inferior maxilla, and of the long bones of the extremities, occasioned by osteomyelitis, by injuries, or by the removal of tumors. Finally, in a class by themselves, are the pseudarthroses.

Notwithstanding the frequent occurrence of all these conditions, the available methods of making good such defects have never been popular.

If, however, there does exist a satisfactory means of replacing these losses in the continuity of bone, its infrequent utilization is to be regretted, for consequential upon them must be mentioned not only a prolonged course of healing but frequently, also, serious deformities and loss of function, a loss often great enough to demand amputation.

In their views upon this subject surgeons have been influenced by the undesirability of implanting in a defect between or within bones any foreign substance, and their belief that all homoplastic grafts must be included in this category.

There is a manifest failure to appreciate the actual fate of a periosteal bone graft. The numerous successful osteoplastic operations upon the cranium, however, should encourage autoplasmic transplantation of bone and periosteum in other locations. On numerous occasions bony buttons or chips have been replaced into cranial defects and successfully healed in. (Kuester, Von Jaksch, Watson Pike, Gerstein, William Jones, Von Braman, Weir, Moller, Eastman, Bunge, Macewen.)

Probably more to the susceptibility of bone and periosteum to successful autoplasmic transplantation than to the preservation of the vascular supply must be attributed the success of

the Haeker-Durante sliding flap method (Durante, Haeker, Sultan, Borchard, Sohr); and it is not impossible that the same statement is also true of even the Müller-König method, for the retention of the vascular supply in either of these methods is small (Müller, König, Schönborn, Mikulicz, Braun, Slajmer, Gussenbauer, Riegner, Korte, Brenanto, Bernay, Von Eiselberg, Karewski, Milko).

It has long been appreciated that foreign bodies of almost any description can permanently be healed within wounds. A. Fraenkel first suggested the use of celluloid plates for the closure of cranial defects, and since that time the procedure has been frequently resorted to with a greater or lesser degree of success (Fraenkel, Billroth, Von Fillenbaum, Weinlechner, Hinterstoisser, Berger, Von Frey, Link, Porges, Fritsch, Pringle, Blecher).

Gluck, Bircher and König have described the successful replacement of losses of bone by pieces of ivory. König still enthusiastically advocates the procedure to correct the deformity produced by resection of portions of the inferior maxilla. Kopfstein replaced a resected upper portion of a humerus with a piece of ivory driven into the remaining part of the humerus below and fitted by a rounding of its upper extremity into the glenoid cavity (Bircher, Gluck, Kopfstein, König).

Lambotte and Elsberg have reported the implantation of aluminium plates within cranial defects and Gerster has utilized gold for the same purpose.

Perhaps the most remarkable instance of the implantation of foreign bodies is recorded by Giordano who permanently replaced a gap of 23 cm. in a tibia with a piece of metal capped on both ends with ivory disks.

Somewhat more extended use has been made of heteroplastic transplantation of bone from animals. Many successful cases have been reported. The literature dates back to 1682 when Jobi Meekren replaced a defect in the cranium of a soldier with a piece of a dog's skull. The implanted fragment healed in perfectly. It is interesting to note that antivivisection cruelty to human beings was in those days more

successfully active, and Jobi Meekren was required to remove the implanted fragment under the ban of excommunication by the church which refused to recognize such "unchristian" methods of treatment. "*Chirurgicum ossis cranii fragmentum anferre jussit, sicque, curatione alia adhibita excommunicationis vim effugit. Jobi a Meekrenobservat medico-chirurg.*" Ex Belgico in lat. transl. of A. Blasio, Amsterdami, 1682, pp. 6-7.

Beginning in the year 1810, the following have reported successful heteroplastic grafting of bone: Merrem, Merrem and Von Walther, Flourens, J. Wolf, Ollier, Goujon, Marshall, Adamkiewicz, White, Sherman, MacGill, Sherwood, Ochotin, Chalot, Forgue, Le Dentu, Ricard, Perier, McGraw, Buchanan, Mosse, Kronacher, Petit, Patzauer, Smolony, Krausch, and Tomita.

Pathologically, of a similar nature is the filling in of losses of bone by decalcified bony chips, first proposed by Senn and subsequently reported upon by Deaver, Le Dentu, Middeldorpf, Mackie, Miller, Murray, Spediacci, Curtis, and Wagenknecht.

For the sake of completeness, reference will be made to the heteroplastic transplantations with preservation of vascular connections by Phelps and Morton, and also the iodoform plug of Mosetig Moorhof. The latter method has received favorable notice by a number of foreign writers and in this country by Wetherill and the Mayo brothers.

None of these methods can be said to be entirely satisfactory. Healing often occurs only after considerable length of time. The formation of fistulæ are not infrequent, and many times a number of the bony fragments have been discharged. In general, they offer a contrast to those cases in which defects in the continuity of bones have been replaced by the implantation of a fresh piece of bone together with its adherent periosteum which is taken from the same individual or another human being.

Recorded instances of this latter method are few in number. They nevertheless indicate that the procedure is one of real

value, and, if subsequent experience proves as favorable, the desirability of more frequently resorting to it is at once apparent and justifies the recording of the author's case.

CASE.—Patient, L. K., an American woman, at present forty-two years of age.

Previous Personal History.—When a child, had malaria and scarlatina followed by a mild nephritis, from which she apparently made a complete recovery. At eighteen years of age she married. During the next three years she had two miscarriages and one child born at term and dying of marasmus when it was five months old. This child had a bullous eruption upon the soles of its feet, some general eruption upon its body, and a condition of the eyes resembling parenchymatous keratitis. Subsequently, the patient had another child who is to-day healthy.

Present Trouble.—Twelve years ago the patient had a severe wrench to her arm, described as a pull accompanied with a sudden twist. She felt considerable pain after this, and three months later she noticed a lump in her arm. This gradually increased in size until seven years ago when she received without benefit a course of mixed treatment.

The growth at that time was hard, nodular and immovably bound down by the muscles of the forearm, in which it caused a fusiform enlargement five inches in length. The whole tumor was exposed and found to be attached to the anterior surface of the ulna by a flattened pedicle. It was removed and the ulna at the point of attachment of the growth curetted. In one year's time a recurrence of the growth was noticed. The recurrent mass measured about two inches in length and was attached to the ulna at the juncture of its lower third and upper two-thirds. This mass was extirpated under general anæsthesia and one year and three months later another small nodule was excised under cocaine. Again, within a few months, a fourth recurrence of the growth was noticed. The patient, however, neglected treatment until November 26, 1908, one year and three months after the preceding operation. She was then placed under the author's care in the Francis E. Parker Memorial Hospital, New Brunswick, N. J.

Fig. 1 represents the size of the growth at that time when the final operation was undertaken. Through an incision along the

FIG. 1.



Condition of forearm immediately previous to operation

FIG. 2.



Condition after healing of operation wound

FIG. 3.



Condition of bones one month after operation.

FIG. 4.



Condition of bones four months after operation.

FIG. 5.



FIG. 6.



Condition of bones fourteen months after operation.

posterior border of the ulna and dividing the joined aponeurosis of the extensor and flexor carpi-ulnaris, the tumor was removed by resecting a portion of the ulna five and one-half inches long, which ran through the centre of the growth.

A fragment of bone of the same length and three-eighths inch wide and one-eighth inch thick was now chiselled off from the crest of the tibia together with its adherent periosteum.

This was then placed between the two extremities of the ulna remaining and fastened in place with silver wire. The periosteum of the implanted fragment was also sutured to the periosteum of the remaining portions of the ulna. The wound was now closed with the exception of a small drain at each end.

After the first twenty-four hours the drains were removed and a plaster splint applied. Thereafter, the wound was dressed on the fourth, seventh, and tenth days, at the end of which time it was healed throughout. At no time was there any elevation of temperature. In two months time the patient could freely use her arm for washing clothes at a tub. Fig. 2 illustrates the healed condition of the arm. Microscopical examination showed that the growth was a chondrosarcoma.

The accompanying radiographs were taken at intervals of one month (Fig. 3), four months (Fig. 4), and fourteen months (Figs. 5 and 6) after the operation. They demonstrate the increase in thickness of the implanted fragment and the formation of callus at its upper end by the implanted periosteum, and at its lower end the direct union of the implanted piece with the ulna.

If we inquire into the nature of the histological processes which have taken place, we must assume as a result of the conclusions of research work upon implanted bone and periosteum that the implanted bone itself had died, but that the periosteum and marrow lived and replaced the old bone with new.

As long ago as 1867 Ollier recognized the important rôle played by the periosteum and marrow. He states: "Quand on a transplanté un os entier, ou une portion d'os garnie de son périoste et de sa moelle, il arrive quelquefois que le périoste seul se greffe; le cylindre osseux se nécrose, se détache, est éliminé, et l'on trouve cependant dans le lieu de la transplantation la gaine périostique ossifiée. Par sa surface externe elle

a adhère aux tissus voisins, et c'est ensuite séparée de l'os ancien nécrosé."

And referring to an experiment in which he successfully transposed the radii of a rabbit he states: "Cette observation nous paraît démonstrer à elle seule la plupart des propositions que nous émises dans ce chapitre la réalité de la greffe osseuse et le rôle du périoste et l'utilité de cette membrane, même dans les cas où le tissu osseux lui même ne se greffe pas."

Subsequent work has, in a large measure, verified and at the same time amplified Ollier's work.

There is a general agreement between the conclusions of Radzimowski, Bonome, Saltykow, Fischöder, Marchand, Sultan, Tomita, Grohe, Morpurgo, Lâwen, Barth (latest publication) and Auxhausen. An examination of the only dissenting works by David, Adamkiewicz, and Laurent, who alone maintain the viability of the implanted bone, will not support their opposing claims.

All others have recognized the death of the implanted bone, its revascularization and penetration by granulation tissue, and through this means the formation of new Haversonian canals, the lining of the new vessels with osteoblasts, and by their agency the absorption of the old bone and the deposition of new bone in concentric layers around the new formed vessels. Finally, that these changes are solely dependent upon the living and regenerative power of the transplanted periosteum and marrow.

The remarkable viability of the transplanted periosteum has been demonstrated by Grohe and Morpurgo, the former showing that it is capable of preservation for one hundred hours and yet able to be implanted and exert its osteogenetic powers. The latter has shown that the periosteum of a corpse kept at 15° can produce new bone when implanted after one hundred and sixty-eight hours. Lâwen has recommended the use of periosteum in the repair of ventral hernia.

The histological demonstration of the viability and regenerative power of implanted periosteum at once places homoplastic transplantations of bone upon an entirely different

footing from any other method of making good bony defects. When the cases of the former method of transplantation are compared with those in which there has been transplanted bone from animals or decalcified dead human bone (Krausch), or even live human bony chips (Macewen), a difference seems to exist in the course of healing of the wounds, in the character of the end result, and in the rapidity with which the latter is obtained. In addition to the author's case, other cases of rather extensive homoplastic transplantation of bone have been reported by Poncet, Kummel, Bardenheuer, Von Bergmann, Klapp, Curtillet, Tomita, Perthes, Lexer, Frankenstein and Roving. Similar small transplantations have been made by Timann, Tietz, Müller, Von Mangoldt, Dryden, and Auxhausen.

In one of Bardenheuer's cases half of the ulna was used to replace a radius.

In Von Bergmann's case a portion of the tibia 11 cm. long was resected for sarcoma and replaced by a piece taken from the fibula.

Klapp replaced the whole of the diaphysis of the humerus (also resected for sarcoma) with a piece of bone and periosteum removed from the crest of the tibia.

Tomita has reported five cases of bone transplantations, two of these were heteroplastic, one was for a pseudarthrosis, and two were fairly extensive autoplasmic implants. In one of the latter, a portion of the tibia 8 cm. long was implanted into a defect 6 cm. long lower down in the same bone.

In the other, a piece of the left tibia 7 cm. long was implanted into a defect of 5 cm. occurring in the tibial diaphysis.

Frankenstein resected 25 cm. of a femur for sarcoma and implanted within the defect a resected fibula. The implanted bone healed in well and formed firm union below, but a pseudarthrosis resulted at the upper end of the implant. In seven months' time the patient died of metastases. Sections of the removed transplanted bone showed active proliferation of its periosteum and marrow and a replacement of the old bone by a network of newly deposited osseous tissue.

Finally, and of considerable importance, is the transplantation of joints by Lexer. In his first publication he reports four functionally successful cases in which portions of bones with adjacent parts of joints have been replaced by bone and cartilage covered with their periosteum or perichondrium.

In his second publication he adds the report of a total transplantation of a knee-joint in a girl eighteen years of age. In eighteen months' time the patient could walk with only a slight limp and rocking of the knee-joint.

Läwen has reported the replacement of the upper half of a humerus resected for sarcoma with a portion of bone and periosteum removed from a tibia. In Rovsing's case two-thirds of the humerus was replaced by the patient's own fibula.

These cases are not numerous but they are sufficient to illustrate the possibilities of homoplastic transplantation of bone and the superiority of the method compared to heteroplastic transplantation or even, as in the case recently reported by Macewen, to the implantation of fresh human bone chips.

Both Tillmann and Tomita, but particularly the latter, who has tried several methods on the human, have commented on this superiority. Tomita states: "Aus den oben aus einander gesetzten Gründen sprechen unsere Fälle vielleicht dafür, dass die methode mit homoplastischer oder autoplastischer Füllung die bessere ist."

Certainly in the author's case the healing of a simple greenstick fracture could not have been more simple; and the ultimate cosmetic and functional result is all that could be desired.

In conclusion the case illustrates the peculiar adaptability of the tibia (its accessibility and its great strength and thickness) to the function of furnishing a suitable bony graft. The radiographs (Figs. 3 to 6) demonstrate that such an autoplasmic graft firmly unites to the fragments between which it is placed and eventually becomes transformed into a thicker piece of living bone, its thickness being determined by the demands for strength required in its new situation. Finally, in the case cited the smooth and rapid healing is an indication that the autoplasmic method of remedying bony defects is the pro-

cedure of choice and is deserving of wider application than it at present is receiving.

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SPONTANEOUS FORWARD DISLOCATION OF WRIST-JOINT.

(MADELUNG'S DEFORMITY.)

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IN reporting these cases we are familiar with the recent articles upon the subject in the German, French and English literature, the only article of any consequence in English being Stetten's² in the *Journal of Surgery, Gynecology and Obstetrics* for January, 1909, who collected 62 cases, some of which we are unable to locate. Our cases and the literature were observed and collected before the appearance of Stetten's article. We feel confident, however, that in view of the lack of literature dealing with this disease in America another short review with report of two cases is justifiable.

History.—Dupuytren⁴ seems to have been the first to call the attention of the profession to this disease, although Begin⁵ made a note of such a condition in a book published in 1825. In 1834 Dupuytren first described it at length, and later referred to another case which appeared in his clinic in 1841. In 1835 Lesauvage⁶ described what he called a "Luxation consecutive de L'articulation radiocarpienne" in a thirty-two year old soldier. In 1847 Smith⁷ reported two cases in his text-book. In 1847 A. Nélaton⁸ refers to a specimen examined by Boinet where unilateral forward displacement was present. In 1855 Malgaigne¹⁰ described a case in a young boy twelve years old, a mason's apprentice with a unilateral forward dislocation of the wrist. Weber¹¹ in 1859 described a case in a young girl eighteen years of age. The wrist was displaced forward, movements were painful and extension very limited. In 1864 Busch¹² referred to a case of marked bilateral forward dislocation of the wrist-joint.

The first anatomical dislocation was reported by Jean¹³ in 1875. Stimson¹⁴ and others doubt whether in this case there was not an old Colles's fracture. To Madelung¹⁵ belongs the credit of first describing this condition in detail, and he reported same at the "Deutsche Gêsellshaft für Chirurgie" in 1878 under the title of "Die spontane Subluxation der Hand nach vorne."

The history of our cases is as follows:

CASE I.—H. J., a girl, fourteen years of age, born in America of Swedish parentage, presented herself for examination in November, 1907.

Family History.—Father died at the age of sixty-two from an accident. Mother living, strong and healthy, her present age fifty-four. Has five brothers and two sisters, two of whom died in infancy. The living are all strong and healthy.

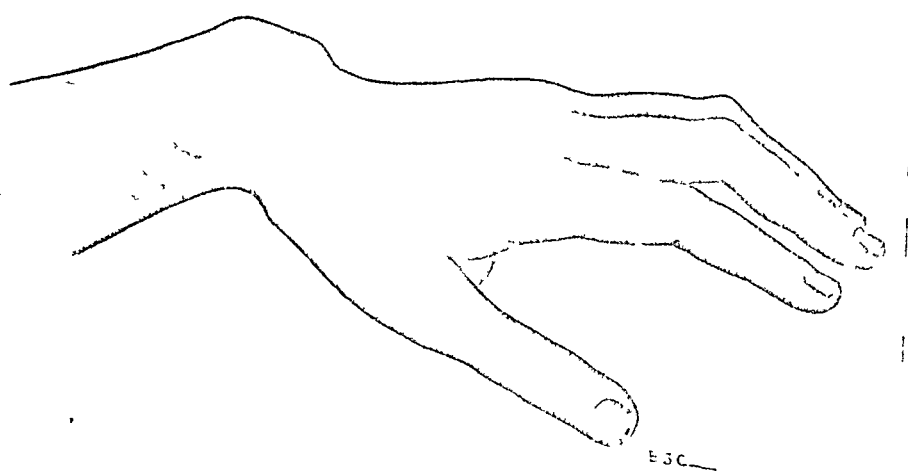
Personal History.—She is a well-built, well-nourished young woman. Had scarlet fever when a child. History otherwise negative to date of present trouble.

Present Trouble—Subjective Symptoms.—Complains of pain in wrists after they have been exercised and when used to raise heavy weights. Pain began about two years ago at the age of twelve. It was first very mild and noticed only when tired. After some months it became more severe and now causes great annoyance when much motion is required at the wrist-joint or when she is required to do heavy lifting. The pain does not bother her when the wrists are at rest. The wrists are not swollen, but she says that they did swell in the first part of her history. No other complaint except compelled to leave school on account of eyes at the age of fourteen.

At the age of nine years she was compelled to work in the field husking corn and "shocking" bundles of grain, and helping "stack" the grain. All of these occupations required overstrain on the wrists of the child. After these extra strains, she says, the wrists swelled and pained her.

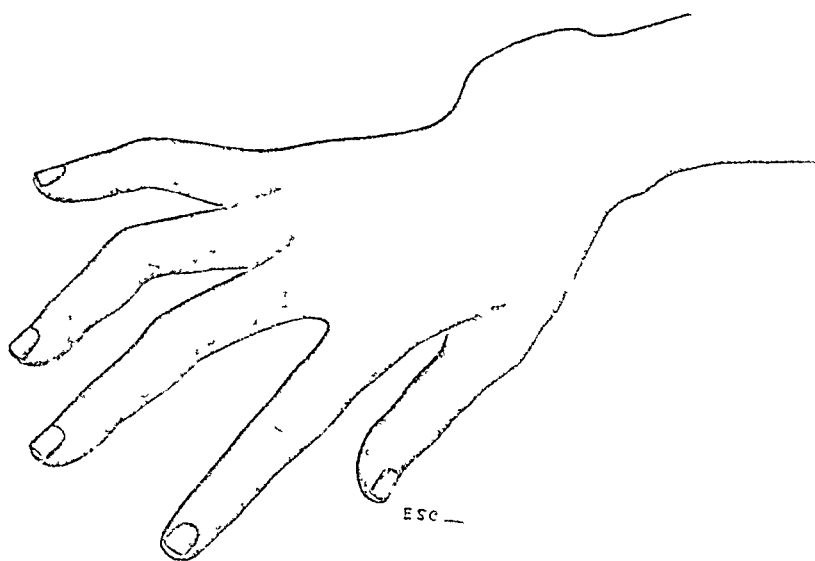
Objective Symptoms.—Eyes, heart, lungs, abdomen, and chest wall negative. No rickety rosary, except there is a marked enlargement of the costochondral articulation of the fifth rib. Both tibiae bowed outward and the distance between the two calves of the leg at the middle point, when the ankles were together,

FIG. 1.



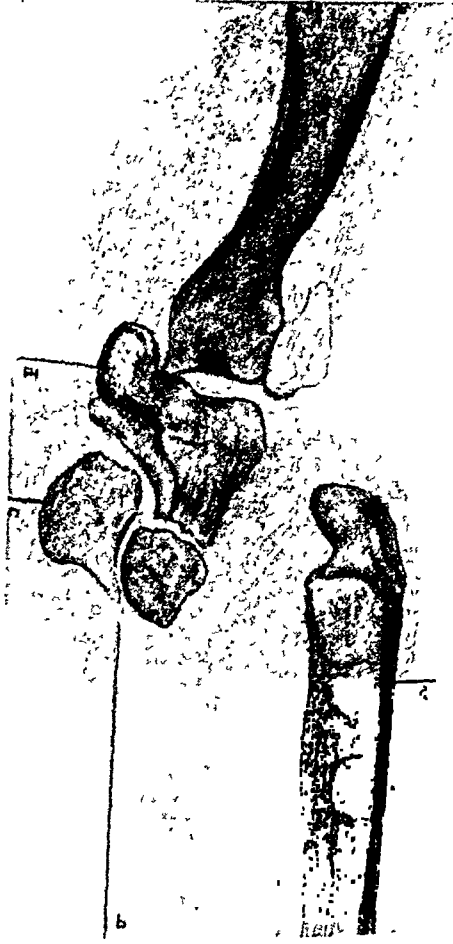
Left hand of Case I in paper.

FIG. 2.



Right hand of Case I in paper.

FIG. 3.



Drawing from a radiograph showing relation
of ulna to carpal bones.

FIG. 4.



Radius of left hand in Case II.

was about two inches as reported to me by Dr. Anderson of Stromsburg, Nebraska. Skull bones normal. Pelvis was not examined. Both wrists present a silver-forked deformity. There was no history of fracture. The carpal bones were dislocated forward, and the line of the ulna with the carpal bones presented a marked anterior curve at the point of articulation of the carpal bones with the ulna. The radiocarpal articulation did not present as marked an angle as the ulnocarpal. The radius, however, was markedly bowed forward in the lower third of the diaphysis, and the epiphysis turned very noticeably anteriorly. The styloid process of the ulna was particularly marked. The entire carpal area dislocated forward. There was limitation of extension in both hands, and forcible extension gave great pain. Flexion was normal, as was pronation and supination. Figures 1 and 2 give a fair idea of this condition. Further examination proved negative. We first observed this case two years ago, and saw it again this winter, 1909. There had been no change.

Diagnosis.—Spontaneous dislocation of both wrist-joints forward or Madelung's deformity.

CASE II.—Miss M. S., age fifteen years.

Family History.—Father and mother well and healthy. No brothers or sisters either living or dead.

Personal History.—Had measles and mumps as a child. Neither of these diseases carried with them any complications. Otherwise personal history is negative. No other disease of childhood nor any other form of disease. She is well nourished and of a good social grade. Has always had good care, plenty of good food, and plenty of fresh air. Has lived in the country the early part of her life. Later lived in small villages. Weight 132 pounds, height 5 feet 3 inches, girth measure 28 inches.

Both tibias are bowed outward and her knees do not touch within an inch and a half. There is no serrated edge to the tibia nor is there any other disease of the bone discoverable. The pelvic bones seem to be normal, there is no rosary. Nodules at the end of the ribs, where the ribs join to the sternum, were not found. Her shoulders, elbows, head, and neck are perfectly normal. Heart, lungs, and kidneys are negative. At about the age of seven and a half she began practising on the piano. At about thirteen years of age she noticed that her wrists were slightly deformed and pained her a great deal upon use. Other-

wise she has never noticed that there was any period in which they swelled or showed any signs of acute inflammation. One physician told her that she had symptoms of exophthalmic goitre at or about this time. Personally we were unable to find any evidence of it. There was no goitre, no tachycardia, or no exophthalmus.

At the present time we find both wrists deformed, ulnar side greater than the radial side, representing the characteristic silver-forked deformity in a mild degree. The styloid process of the ulna stands high above the carpal bone, and the end of the ulna is entirely separated from its articulation of the carpal bone. The radius is not so far removed from its articulation, but the carpal bones are removed from the exact position with the radius and are dislocated forward, and the epiphyseal ends of the ulna and radius are separated and the radius moved easily upon the ulna. The carpal bones are undefinable so far as palpation is concerned, the semilunar and scaphoid being entirely removed from definition. Pronation, supination, and flexion are normal. Extension is slightly limited. The hands are apparently as strong as ever, but when used much or examined much pain follows. The ends of the radius and ulna are smaller than normal. The epiphyses apparently are not well developed, as also one is inclined to think from palpation that the carpal bones are lacking in their development.

I am indebted to Dr. Mitchell, of Osceola, Iowa, for this case.

Etiology.—We have found 58 cases reported, as follows Abadie,¹⁶ 8 men, 28 women; Poulsen,¹⁷ 2 women; V. Bergmann,¹⁸ 1; Cnopf,¹⁹ 1; Bermeiche, 1; Pels-Leusden,²¹ 2; Sauer,²² 3; Schulze,²³ 1; Volkmann,²⁴ 2; Putti,²⁵ 1; Stieda,²⁶ 1; Bode,²⁷ 1; Barthès,²⁸ 2; Lesauvage, 1; Franke,²⁹ 1; Peckham,³ 1; Bennett,¹ 1.

Both sides in 31 cases, one side in 26 cases, of these last nine right and 13 left were described as affected side. In two cases a complete description was not found.

These cases have been accounted for by various hypotheses regarding the position of the bones and the articular ligaments. None of these hypotheses have been very definite and each author has given different ideas regarding them.

The two most classical descriptions have been made by Madelung and Delbet,³⁰ respectively. Madelung collected twelve cases and was able to study one case at autopsy, and described his case quite thoroughly.

He taught that the flexors of the forearm being so much stronger than the extensors pulled the radius backward and held the carpal bones forward, thus producing a partial separation of the scaphoid and semilunar from the radius and ulna.

A primary bone degeneration appeared to Madelung to be indispensable. He did not accept the French idea that trauma or occupation could produce the deformity. Other authors are of similar opinion, as for example, Malfuson,³¹ Dekeyser,³² Gevaert,³³ Kirmisson,³⁴ and Delbet. Many of them go a little farther and not only show a deformity and degeneration of ends of bone, but also claim it is a symptom of rhachitis. Some authors, as Volkmann and Malfuson, have reported the sudden appearance of the deformity, while Jean and Ardouin³⁵ speak of it as congenital, without, however, proving their position either by facts or history. Poulsen believed it to be due to a rarefaction osteitis, which he thought to prove from the curving, thickening, and shortening of the bones of the forearm. A great many French authors think the deformity to be due to trauma, which in a certain number of the cases was light and without immediate results, while in others a definite trauma could be determined (Guéry,³⁶ Lesauvage, Malgaigne, Abadie). Occupations such as shoemakers, typesetters, carpenters, and the like, where the wrist is much used, are given as a cause.

Delbet considers it possible with ossifications of the cartilages of the joint which was described by Bessel-Hagen.³⁷ In many cases they seem to vary from the Madelung description of "Spontaneous Subluxion."

Barthès describes two forms of the deformity, viz.: (1) "Luxation Progressive of Adolescence;" (2) "Luxation Progressive of Adults."

The spontaneous subluxation of adults as described by Barthès does not appear to answer the question, because the

cases so far observed are nearly all in young people. The author's cases began at twelve years, Franke's case at thirteen years. Of Madelung's twelve cases only two were over twenty-three, and there appears to be some doubt about one as to whether it really was a true case of spontaneous dislocation or a fracture. The remainder of the cases were all under eighteen years.

Pathological changes, as osteomalacia, usually appear later in life, and are slowly progressive, most frequently found in women, affect the shaft of the bone rather than the epiphysis, and the periosteum is thickened and hardened. They more frequently affect the pelvis and are not confined to one bone or joint or two joints. We cannot accept these cases, therefore, as fitting under the symptom complex of the condition known as osteomalacia.

The observed pathological changes may be described briefly as follows: The epiphyseal ends of the bone are irregular, excurved, and not completely developed. They present the appearance of having been impeded in the completion of the edges and cartilages of the epiphysis. The end of the bone is not so large as normal. It is club-shaped and the processes will not hold the carpal bones in place on the volar side. The same is true of both ulna and radius. The cartilages between the carpal bones and the epiphyseal cartilages are imperfect, ossified in places, and irregular in thickness, and wanting at other points. The volar side in general presents the appearance of a dystrophy (Franke and Poulsen). They also often present hypertrophy of the dorsal edge, as did our case (Weber, Busch, Madelung, Schulze, Bennecke,⁸⁸ Franke).

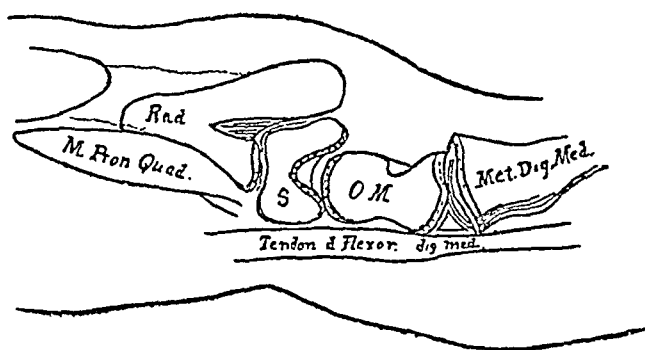
Franke gives a most detailed pathologic description. He concludes that there is not a true dislocation, but only a deviation of direction due to change in the curve of the radius not so much in the direction of the diaphysis as of the epiphysis which is always present. This is also Madelung's idea. There has been, however, constantly found in the later observations a bending of the diaphysis and Stetten agrees with Delbet, that the chief cause of the deformity is the throwing

forward of the articular plane of the radius sufficient in degree to make an apparent dislocation. This was true of our cases. The radio-ulnar articulation is much more widely separated than normal, thus giving artificial and exaggerated movements of the carpal bones and of the hand (Figs. 3 and 4). Our cases did not seem to be as pronounced as Madelung's, as shown by Figs. 5 and 6.

The etiology and pathology of this peculiar deformity are, therefore, not entirely explained. We may, however, from our study of these cases, draw the following conclusions:

First. They occur in people usually of the lower class, many of whom show evidences of rickets.

FIG. 5.



Showing relation of end of radius to carpal and metacarpal.

Second. There is a dystrophy and atrophy in the carpal bones, cartilages, and epiphyses, with an occasional hypertrophy of the dorsal side, and the diaphysis of the radius is curved anteriorly. This corresponds to Delbet's description of the spontaneous subluxations of adolescence.

Third. Radical treatment is only indicated for cosmetic purposes. Symptoms must be controlled by palliative means.

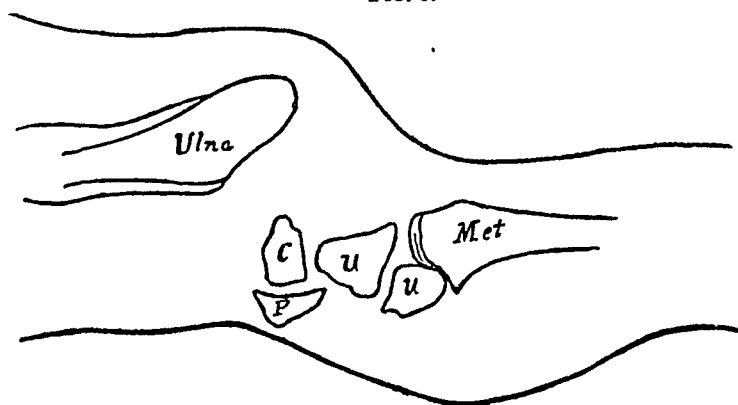
Fourth. Heredity, female sex, and occupations are predisposing factors to this disease.

Treatment.—While sometimes osteotomy may be justifiable when the deformity is very great, yet it is not indicated except for cosmetic effects and then it is questionable in its results. Ordinarily plaster casts, splints, etc., are useless. After about

the age of twenty-five all symptomatology disappears. Therefore, palliative treatment is indicated up to that age, or to the disappearance of the symptoms. The treatment must be counterirritation, rest, and overfeeding. Osteotomy may be used after the period of symptoms has passed. In our cases we were not ready to do anything and advised the wrists being let alone.

Prognosis.—The prognosis is good as to life. The patient will complain of some pain for several years upon exercise of

FIG. 6.



Showing relation of end of ulna to carpal and metacarpal.

the wrists. Ultimately symptoms will disappear, and the resultant process will be a deformity of the wrist-joints known as the silver-forked deformity.

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THE CYSTOSCOPIC EXAMINATION IN RENAL TUBERCULOSIS.

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THE object of this paper is two-fold. First, to give the proper diagnostic value to the cystoscopic examination in renal tuberculosis. Second, to picture as accurately as possible the changes in the ureteral orifices in this disease.

Walker in his article, "Tuberculosis of the Bladder," ANNALS OF SURGERY, Feb., Mar., Apr., 1907, indicates the importance of the cystoscopic examination when he says: "There is no sign or symptom, nor is there a definite symptom-complex which indubitably proves the presence of tuberculosis of the bladder. . . . The same frequent and painful micturition and the general bladder distress which accompanies tuberculosis of that organ are also produced to nearly the same degree of intensity by tuberculosis of the kidney, and almost the same symptomatic picture is presented by certain cases of tuberculosis of the prostate."

I can add to this, if the tuberculosis be renal there is no one symptom or class of symptoms which can unquestionably fix the tuberculosis in one side or the other. Pain, kidney enlargement, and so forth, may be wholly on the normal side.

The *relative frequency* of primary involvement of different portions of the genito-urinary tract is of interest and should be kept in mind when a diagnosis is being made. I again quote from Walker. In 279 cases "the kidney seemed to be first implicated in 184; the epididymis in 80; the prostate in 6; the Fallopian tubes in 6; the seminal vesicles

* Read before the Genito-Urinary Section, Academy of Medicine, Feb. 17, 1909; and before the New York Society, American Urological Association, May, 1909.

in 2; the uterus in 1." That is in about two-thirds of all cases the kidney contains the primary focus as far as the genito-urinary organs are concerned. Also, "clinically primary bladder tuberculosis has been reported often, but as the pathology is being more carefully studied we are becoming convinced that these reports are erroneous." "... while primary tuberculosis of the bladder is a possibility, for practical surgical considerations its existence may be disregarded."

The Pictures.—At the present time very few adequate pictures of the changes in the ureteral orifices occurring in renal tuberculosis exist. Fenwick, in his classic work, "Ureteric Meatoscopy in Obscure Diseases of the Kidney," 1903, has a few pictures which have been extensively copied.

It is to be regretted that the pictures which I have collected are not photographs. The present photographic cystoscopes are, however, entirely inadequate to produce pictures of much worth. The poor illumination, slow lenses, and very often clouding medium all contribute to the production of poor pictures.

All of the pictures I have made are from sketches made at the time or after the cystoscopic examination. The indirect or prismatic cystoscope of either the Nitze or Otis type has been used in all of the observations. The field of catheterizing cystoscopes is too small to allow good examination of the ureteral orifice.

Site of Involvement.—If the kidney contains the primary focus of the disease the cystoscopic examination will show the primary involvement of the bladder around that ureter. If the disease comes from the epididymis and prostate the lesions are first around the vesical neck and trigone. The cystoscopic examination may, however, be very misleading as is shown by Case VI. In this case the cystoscopic picture was typical of a tuberculosis ascending through the prostate to the bladder. Yet in one kidney was the principal if not the primary focus.

Rigid Ureteral Orifice.—In most cases of renal tubercu-

losis, whether the process be a recent or an old one, and whether the bladder be involved much or little, the ureteral orifice of the affected side is rigid, non-contracting.

"With normal ureters the contractions of the ureteral orifices indicate that urine is flowing through them; and the contracting of the orifices also indicates contractions of the ureters as a whole. When we turn from normal to diseased ureters the conditions change. When the ureter itself becomes diseased there naturally follows grave disturbance of the ureteral contractions."¹

In probably all but in certainly six of the cases the ureteral orifice was rigid. In four of these cases the urine from either kidney was obtained by the use of the Luys' separator—the disturbance to the ureteral contractions being less than if the ureteral catheter had been used—and the flow of urine from the diseased side, while irregular, was always interrupted, indicating that definite ureteral contractions took place. This disturbance to the ureteral function is, as far as we can observe, most patent in that portion of the ureter which presents itself to the cystoscopic view—the ureteral orifice—this being rigid when apparently contractions are taking place in other parts of the ureter.

"This might suggest that the vesical portion of the ureter was the most markedly affected of any portion in a so-called descending tuberculosis of the urinary tract. And this would be natural, as the ureter is constricted for a considerable distance where it passes through the bladder wall, and this constricted portion, as well as the portion just above, would form an excellent lodging place for tubercle bacilli."

The other explanation that might be given to this failure of the ureteral orifice to contract at the same time that peristaltic contractions in the ureter as a whole are taking place, is that in normal contractions of the ureters the part of most vigorous contraction is the middle third of the ureter. Lucas says " . . . the middle part of the ureter (comprising at

¹ Barringer: Observations on the Physiology and Pathology of the Ureteral Function, *Folio Urologica*, Band ii, 1908.

least two-thirds) shows comparatively large contractions . . . The uppermost part of the ureter shows contractions of another type, namely small oscillations . . . The contractions of the lower end of the ureter are generally more frequent and not nearly so large as those . . . at the middle part."

"So if the entire ureter were diseased the contractions would persist longest where, under normal conditions, they were largest and strongest." ²

The former explanation is, I believe the correct one.

Relation between the Kidney, Ureter and Bladder Changes.

—There are two conditions so frequently seen in renal tuberculosis as to almost make them peculiar to this disease.

First: When there is entire destruction of one kidney and extensive bladder tuberculosis, we often see the ureteral orifice of the other kidney entirely normal, and obtain entirely normal urine, as regards pus and tubercle bacilli, from this kidney. Such a condition is seen in Case IV.

Second: With partial or complete destruction of one kidney, with a process that must have extended over a period of years, we frequently find with the exception of the ureteral orifice of the affected kidney, the entire bladder normal. Cases I, II, and III illustrate this.

With these two classes of cases the tuberculosis is probably primary in the kidney and both of these conditions would seem in a measure to be dependent upon the frequency of urination so characteristic of renal tuberculosis. The infective material from one kidney does not stay in the bladder for a period of time long enough to affect it. This frequency seems to be a natural prophylaxis against the extension of the tuberculous process both to the bladder and to the other kidney. In contrast with this we comparatively often see bilateral kidney involvement in conditions causing retention of bladder fluid—as ureteral stricture, and prostatic enlargement.

The course of a kidney involvement arising from a bladder

² Barringer: *loc. cit.*

infection, is probably as follows: The bladder is involved and with it the bladder portion of the ureter. The bladder portion of the ureter becomes strictured, so causing hindrance to the excretion of urine from that kidney. This causes the kidney to become a point of lowered resistance, a fertile field for the growth of organisms that may be in the blood. The frequency and lack of bladder retention in renal tuberculosis often prevents, I believe, this affection of the bladder portion of the ureter and so the kidney.

The opposite and apparently rarer condition—slight kidney involvement with marked bladder changes, as seen in Case V—would be perhaps explained by the fact that the original focus, as far as the genito-urinary organs are concerned, starts in the bladder or prostate, and there is secondary involvement of the kidney. It is possible, also, that these cases have a certain amount of bladder retention. The cases which I have seen shed but little light upon this question.

Relation between the Extent of Kidney Involvement and Cystoscopic Changes in the Ureteral Orifice.—Fenwick has attempted to estimate the extent of kidney involvement by the ureteral changes. I am not at all sure that this can be done. Cases I and II are illustrative of this. In these cases there is no marked thickening of the intravesical portion of the ureter, no marked retraction,—yet in both cases the kidneys were practically destroyed. I can conceive that a ureter that is markedly thickened and retracted might point to an advanced process in the kidney, but even this rule might be fallible. In Case VI there is no change in the ureteral orifice, while the kidney was probably wholly destroyed,—sclerotic, not excreting anything through the ureter.

I believe that grave errors may arise if the cystoscopic picture is alone used to estimate the extent of the kidney lesion.

Clinical Value of the Cystoscopic Examination.—If a cloudy medium or a badly inflamed bladder does not interfere with the cystoscopic view we can nearly always determine which kidney is involved. An example of this is shown in

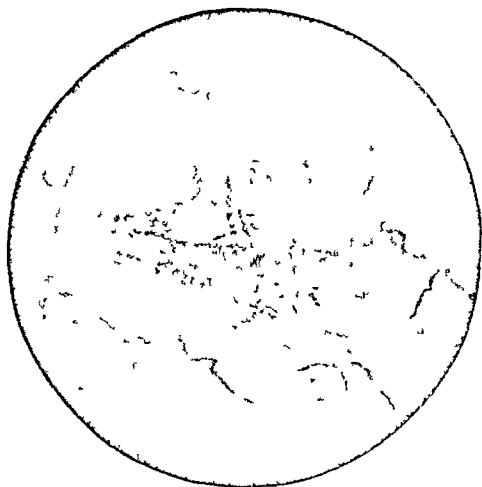
Case VII where the bladder irritability interfered with ureteral catheterism or urinary separation. The simple cystoscopic view determined which kidney was involved and the operation confirmed this.

If on careful examination one ureteral orifice is found to be absolutely normal, contracting and excreting urine, I believe that almost always the kidney corresponding to that ureter has a normal functional capacity and is excreting normal urine—normal as regards pus and tubercle bacilli. Notwithstanding this, in every case of renal tuberculosis there should be a determined attempt to either catheterize the ureters or perform urinary separation. If ureteral catheterism is performed it is probably better to catheterize the normal ureter and obtain the urine from the diseased kidney by means of a catheter in the bladder. There are two reasons for this: First, we wish to find if the presumably well kidney is excreting normal urine. Second, I think that, contrary to what is generally believed, there is less danger of renal infection from the ureteral catheter when a normal ureter is catheterized than when a diseased one is. If both ureters are diseased urinary separation or double ureteral catheterism should be performed.

The Cases.—The eight cases³ which I have chosen show all of the ureteral changes which are described as belonging peculiarly to renal tuberculosis. In most of the cases both ureters are pictured, so allowing a comparison between the diseased and healthy ureteral orifices. In examining the ureters which I have called normal, a number of different types will be seen. They all correspond, however, to one general type. They are not ulcerated, they are neither swollen nor puffy; some of them show slight congestion which is not enough of a departure from the strictly normal to be of any diagnostic significance; some are larger than others but all

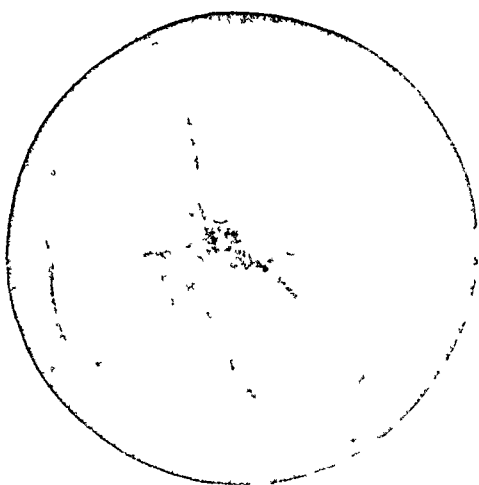
³A majority of the cases here reported are cases of Drs. C. H. Chetwood and E. L. Keyes, Jr., to whom I am indebted for the use of this valuable material.

FIG. 1.



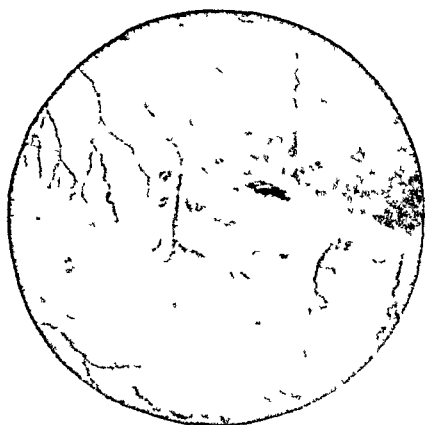
Case I.—Right ureteral orifice of tuberculous kidney, before nephrectomy.

FIG. 2.



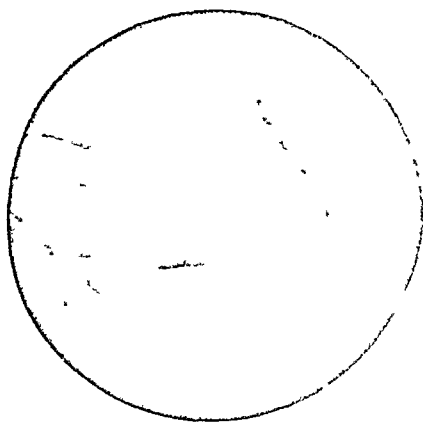
Case I.—Right ureteral orifice, two months after nephrectomy.

FIG 3



Case II —Right ureteral orifice.

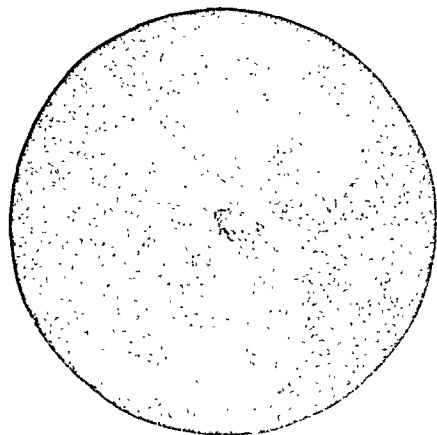
FIG 4.



Case II.—Left normal ureteral orifice

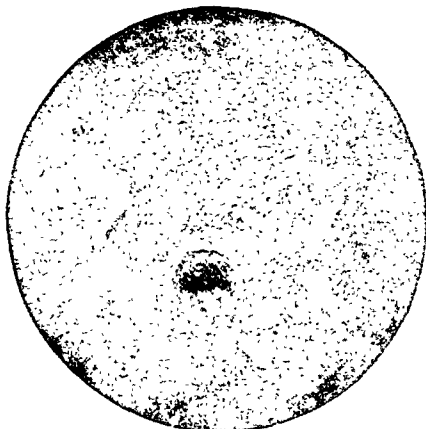


FIG. 9.



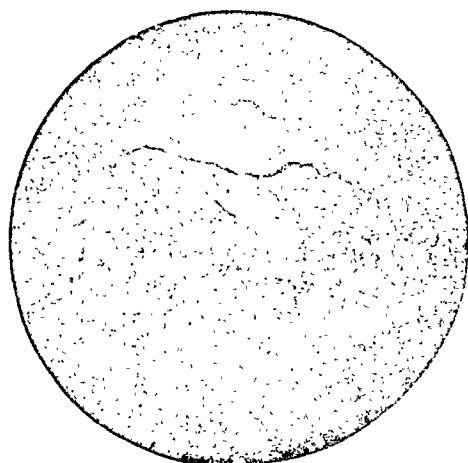
Case V.—Right ureter. Ureter itself apparently normal, contracting.

FIG. 10.



Case V.—Left diseased ureter. Rigid, ulcerated, golf hole.

FIG. 11.



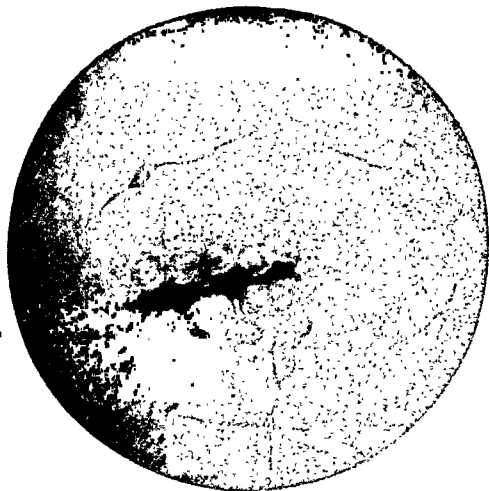
Case VI.—Intravesical portion of prostate; nodular, covered with pink tubercles.

FIG. 12.



Case VI.—Left ureter. Kidney normal; pink tubercles around trigone.

FIG. 13.



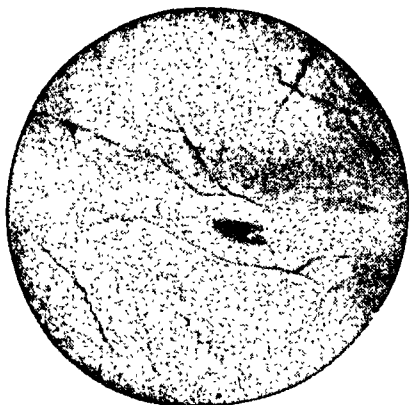
Case VII.—Left ureter, before nephrectomy. Kidney showed caseous areas. Bullous œdema around ureter.

FIG. 14.



Case VII.—Left ureter, one month after nephrectomy. Bullæ entirely gone.

FIG. 15.



Case VIII.—Right ureteral orifice. Normal, contracting.

FIG. 16.



Case VIII.—Left ureteral orifice. Apparently rigid; otherwise normal. Kidney was tuberculous.

within the bounds of the normal. After the study of a series of cases with an adequate cystoscope (I have used exclusively the prismatic) it is not difficult to recognize and classify the variations of a normal ureter.

Cases I, II, III and IV show changes in the ureter which are practically only seen in renal tuberculosis. Case VI showed no ureter changes but a bladder tuberculosis, while the main lesion was in one kidney. Cases VII and VIII showed changes which may occur in conditions other than renal tuberculosis. All of the cases, with one exception (Case VI), have been proved either by operation or the finding of tubercle bacilli in the urine to be tuberculous. Six of the cases have been operated upon. In five cases the urine from either kidney has been obtained by ureteral catheterism or urinary separation. All of the cases have been cystoscoped before operation and two after operation,—Case I two months after nephrectomy, Case VII one month after nephrectomy.

REPORT OF CASES.

CASE I.—Miss O'H., 26 years of age, single, History of frequent and burning urination for the past four months. Urine has been thick and turbid for the past week. Has lost no weight. Right kidney palpable, enlarged and tender.

Cystoscopic Examination.—Bladder capacity, 175 c.c. Bladder urine cloudy, but bladder washings returned clear after two irrigations. Right ureteral orifice (Fig. 1) surrounded by red granulations, with a few submucous hemorrhages, noncontracting; no ulcerations. Left ureteral orifice normal, contracting regularly, clear urine issuing. The rest of the bladder entirely normal.

ANALYSIS.

Separation of the Urines with the Luys' Separator.

	Right urine.	Left urine.
Quantity	3 c.c. in 15 min.	8 c.c. in 15 min.
Color	Colorless	Yellow.
Reaction	<i>Neutral.</i>	<i>Acid.</i>
Appearance	Turbid.	Clear.
Albumin	Trace.	Marked trace.
Urea	1 gram to litre.	25 grams to litre.

MICROSCOPICAL.

Blood	Moderate No. fresh.
Pus Many pus-cells.	Rare leucocyte.
Bacteria <i>Tubercle bacilli.</i>	None.

The urinary separation was exact, even the reaction of the two sides being different. The total urea excreted by either side indicated that the right kidney was practically non-functionating. At operation I found the right kidney to be composed of large abscess cavities, practically destroyed; it was removed.

Two months after nephrectomy the cystoscopic examination of the right ureteral orifice (Fig. 2) showed that the red granulations had entirely disappeared, and normal mucous membrane surrounded the closed, rigid ureteral mouth; indicating involution of the tuberculous process in the urinary system.

Remarks.—These red granulations surrounding a ureteral orifice are seen only in renal tuberculosis. From neither the history, the physical signs nor the cystoscopic examination could any idea of the extent of the process be gained. Examination of the urine from either kidney gave the only accurate knowledge of the extent of the process.

CASE II.—Case of Dr. Beck, New Haven. History: Patient diagnosed as having hip disease (some months before seen). Had pain in right lumbar and inguinal regions. Has a large cold abscess over right iliac crest. Urine contained pus and tubercle bacilli.

Cystoscopy.—Bladder capacity 150 c.c. Urine cloudy. Right ureteral orifice (Fig. 3): Retracted to right; much thickened. Orifice small, irregular; surrounded by an area of pink granulations with a few conglomerate tubercles. Left ureteral orifice (Fig. 4): Normally placed and normal in appearance. The rest of the bladder entirely normal.

Ureteral catheterism was not performed because of lack of time.

Operation.—Dr. Beck and I removed a right tuberculous kidney, almost completely destroyed. The patient is convalescing, now some weeks post-nephrectomy.

Remarks.—This picture could not be mistaken for anything else than renal tuberculosis. The diagnosis could be made without finding tubercle bacilli in the urine. As a rule this cystoscopic picture is seen with an old process with extensive kidney destruction.

CASE III.—Mr. J. C., 35 years, married. Gonorrhœa four years ago. One and a half months later could not urinate; catheterized. Since then bladder irritation. Weakness of back; no especial pain in kidney regions. Has lost 15 to 20 pounds in last year. Night sweats. Now urinates daily every 2 to 3 hours; at night seven or eight times.

Cystoscopic Examination.—Bladder urine very cloudy; bladder washed clean after eight to ten irrigations. Moderate congestion and cystitis of base of the bladder. Right ureteral orifice (Fig. 5): Open; rigid; surrounded by slight congestion. Small ulceration at one angle. Left ureteral orifice (Fig. 6): Slightly congested, contracting regularly every ten to twelve seconds. Urine issuing.

Ureteral Catheterism.—Urine ran irregularly from right catheter and regularly from left.

ANALYSIS.

	Right urine.	Left urine.
Quantity	4 c.c. in 10 min.	5½ c.c. in 10 min.
Color	Light yellow.	Amber.
Appearance	Cloudy.	Slightly cloudy.
Precipitate	Moderate.	Slight.
Reaction	Faintly acid.	Acid.
Albumin	Heavy trace.	Slight trace.
Urea	1 gram to litre.	16 grams to litre.

MICROSCOPICAL.

Red blood-cells..	Rare.	Rare.
Pus-cells	Many.	None; rare leucocyte.
Bacteria	<i>Tubercle bacilli.</i>	None.

The "total urea" of the normal kidney was twenty-two times as much as that of the diseased, indicating practically an entire lack of kidney function of the diseased kidney.

One year later the patient returned with a left tuberculous epididymitis. Separation of the urines at that time with the

Luys' separator gave practically the same results as the ureteral catheterism with the exception that the process in the right kidney had extended, the fluid excreted from the right kidney containing not even a trace of urea. Examination of the nephrectomized kidney showed complete destruction of kidney tissue, with large cavity formation. The patient died on the second day after nephrectomy from heart failure. He passed a sufficient amount of urine up to time of his death.

Remarks.—Again the cystoscopic picture gave no index of the extent of kidney involvement. The cystoscopic picture of the diseased ureter is but very rarely seen with conditions other than renal tuberculosis.

CASE IV.—Hazel T., 14 years old. History of increased frequency of urination and cloudy urine for the past eighteen months. Right kidney tender on deep pressure.

Cystoscopic Examination.—Bladder capacity 50 c.c. Urine cloudy. Right ureteral orifice (Fig. 7): Enlarged, thickened and rigid; ulcerated in places. Left ureteral orifice (Fig. 8): Normal and contracting. Base of bladder congested and the site of chronic cystitis in places.

ANALYSIS.

Separation of the Urines with the Luys' Separator.

	Right urine.	Left urine.
Quantity	4 c.c. in 12 min.	20 c.c. in 12 min.
Color	Yellow.	Yellow.
Appearance	Cloudy.	Clear.
Albumin and urea	Not taken.	Not taken.

MICROSCOPICAL.

Blood	Few red blood-cells.	Many red blood-cells, (traumatic).
Pus	Many blood shadows.	No pus; few leucocytes.
Epithelium	Much pus.	Oc. renal; oc. vesical.
Casts	Much renal.	1 epithelial; 2 hyaline.
	Oc. hyaline and granular.	
Bacteria	Many tubercle bacilli.	No tubercle bacilli.

Remarks.—Renal tuberculosis is the only condition which gives this cystoscopic picture. Enlarged, thickened, rigid, ulcerated ureteral orifice. The left kidney excreted practically normal urine and the left ureteral orifice was normal notwithstanding the surrounding cystitis of the bladder.

CASE V.—William A., 33 years, married. Case of Dr. C. H. Chetwood. Chief complaint at present, pain in right kidney region, and frequent day (15 times) and night (20 times) urination.

Cystoscopic Examination.—Bladder capacity 30 c.c. Urine cloudy; bladder irrigations returned clear after 6 to 7 washings, but rapidly reclouded. Bladder ulcerated; many submucous hemorrhages. Ureters not seen. Urinary separation failed. The separator could not be introduced into the bladder because of the rigid bladder neck.

Phloridzin test: Fifteen minims of a 1 per cent. phloridzin solution (in 33 per cent. alcohol) injected in arm. Suggestion of sugar at 40 minims post-injection; strongly positive at 50 minims.

Second Cystoscopic Examination (Two days after first failure).—Right ureter (Fig. 9): Small, normally placed, contracting; surrounded by submucous hemorrhages. Apparently fairly normal. Left ureter (Fig. 10): Golf hole, rigid; surrounded by ulcerations. Entire base of bladder covered with small submucous hemorrhages and ulcerated areas.

Nephrectomy.—Left, by Dr. Chetwood. Specimen showed tuberculous kidney with abscesses. Much normal kidney tissue in specimen.

Phloridzin test two weeks after operation: Suggestion of sugar 25 minims post-injection; positive at 30 minims.

Some months after operation the patient died, probably from a general tuberculosis.

Remarks.—The right ureteral orifice did not look entirely normal. The left ureter was, however, so markedly diseased that it was deemed advisable to explore the left kidney. Finding abscesses in this it was removed. Unfortunately the case was not cystoscoped after the operation. The better excretion of phloridzin after operation would seem to indicate that the remaining kidney was not diseased.

CASE VI (Case of Dr. C. H. Chetwood).—T. F. B., aged 46. Hæmaturia four, three, and two years ago. Patient is said to have passed a calculus two years ago. In 1894 left testicle and epididymis removed for alleged tuberculosis. Chief complaint is pain in right side which is aggravated by movements of the body; and marked urgency and frequency, but no pain.

Cystoscopic Examination.—Bladder capacity 200 c.c. Urine cloudy. Bladder fluid returned clear after six to seven washings and remained clear. All over the base of the bladder and especially marked near the left ureteral orifice are irregular patches of small pink tubercles between

which is normal mucous membrane. Right ureteral orifice: Normal. Left ureteral orifice: Normal contracting (see Fig. 12). Prostate: The intravesical portion of the prostate is nodular and covered with the same pink tubercles (Fig. 11).

Urinary separation (with the Luys' separator):

The separator was introduced without pain and remained in place thirty-six minutes. In that time three-fourth c.c. flowed from right side and 20 c.c. from the left.

ANALYSIS.

	Right urine.	Left urine.
Quantity.....	Three-fourths c.c.	20 c.c.
Color.....	White.	Bluish (from ind.-carmin)
Appearance....	Clear.	Slightly flocculent.
Albumin.....	Negative.	Trace.
Sugar.....	Negative.	Negative.
Urea.....	Negative.	18 grams to litre.

Indigo Carmin Test: Some minutes before the introduction of separator, 4 c.c. of a three per cent. solution of indigo carmin injected into buttock with following results: Right side.—No blue up to 41 minutes. Left side.—Blue in 13 to 14 minutes post-injection.

Remarks.—Notwithstanding the fact that no tubercle bacilli were found in the urine, the diagnosis of urinary tuberculosis was unquestioned because of the history and the cystoscopic picture. Both ureters were normal; but, as the affected right kidney was excreting nothing into the bladder, this is natural. This case well demonstrates the danger of making a diagnosis by means of the cystoscopic examination alone as suggested by Fenwick.

CASE VII.—H. P. E., 36 years old. (Case of Dr. C. H. Chetwood.) Hæmaturia, once many years ago. Swollen right testicle 11 years ago; left epididymitis six weeks ago, which left the epididymis swollen and hard. Principal complaint, pain in left lumbocostal region. Urination normal.

Cystoscopic Examination.—Urine cloudy; bladder fluid returned clear after five to six irrigations but rapidly reclouded. Right ureteral orifice: Normal, contracting regularly. Left ureteral orifice (Fig. 13): Surrounded by small pink nodules, either bullæ or tubercles; rigid non-contracting. There were a few small patches of cystitis of the bladder base.

Ureteral catheterism or urinary separation was not attempted because of the extreme irritability of the bladder.

The urinary examination showed pus; slight trace of albumin, but no tubercle bacilli on two examinations.

Diagnosis.—Pyuria of left kidney origin, probably tuberculous.

Operation by Dr. Chetwood. The kidney was found to have a number of abscess and large caseous foci in the lower pole.

Cystoscopic Examination (One month after nephrectomy).—Bladder urine slightly cloudy; bladder washed clear in two to three irrigations. Right ureter normal, contracting. Left ureter (Fig. 14), rigid, closed; bullæ around the orifice have entirely disappeared. Bladder otherwise normal.

Remarks.—The changes around the ureter were probably not due to the formation of tubercles, as these would probably not disappear in one month. Rather they were bullous œdema. This bullous œdema is not all characteristic of tuberculosis. I have seen it with stone in the lower portion of the ureter, cystitis, pyogenic infections of the kidney, etc. Again we have slight bladder change with marked kidney destruction.

CASE VIII (Case of Dr. E. L. Keyes, Jr.).—A. G., male, 34 years old. Seven years ago frequent and painful urination. Four years ago pain in left kidney. One year later abscess in right kidney region; opened.

Cystoscopic Examination.—Urine cloudy. Bladder irrigations returned clear after four to five washings and slowly reclouded. Right ureteral orifice (Fig. 15), contracting regularly and frequently; apparently clear urine coming forth. Left ureteral orifice (Fig. 16) apparently rigid, and pus coming forth. No ulcerations, no changes in the mucous membrane.

ANALYSIS.

Ureteral Catheterism.

	Right urine.	Left urine.
Quantity	4 c.c.	5 c.c.
Color	Red.	Whitish.
Appearance	Slightly cloudy.	More cloudy.
Albumin	Marked trace.	More marked trace.
Urea	26 Gm. to litre.	20 Gm. to litre.

MICROSCOPICAL.

Red blood-cells .	Number (traumatic).	Rare.
Pus	None, few leucocytes.	Much pus.
Epithelium	Rare renal.	Kidney cells.
Bacteria	No tubercle bacilli.	No tubercle bacilli.

which is normal mucous membrane. Right ureteral orifice: Normal. Left ureteral orifice: Normal contracting (see Fig. 12). Prostate: The intravesical portion of the prostate is nodular and covered with the same pink tubercles (Fig. 11).

Urinary separation (with the Luys' separator):

The separator was introduced without pain and remained in place thirty-six minutes. In that time three-fourth c.c. flowed from right side and 20 c.c. from the left.

ANALYSIS.

	Right urine.	Left urine.
Quantity.....	Three-fourths c.c.	20 c.c.
Color.....	White.	Bluish (from ind.-carmin)
Appearance....	Clear.	Slightly flocculent.
Albumin.....	Negative.	Trace.
Sugar.....	Negative.	Negative.
Urea.....	Negative.	18 grams to litre.

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ANALYSIS.

Ureteral Catheterism.

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Quantity	4 c.c.	5 c.c.
Color	Red.	Whitish.
Appearance	Slightly cloudy.	More cloudy.
Albumin	Marked trace.	More marked trace.
Urea	26 Gm. to litre.	20 Gm. to litre.

MICROSCOPICAL.

Red blood-cells .	Number (traumatic).	Rare.
Pus	None, few leucocytes.	Much pus.
Epithelium	Rare renal.	Kidney cells.
Bacteria	No tubercle bacilli.	No tubercle bacilli.

Nephrectomy (by Dr. Keyes).—A kidney was removed with a tuberculous focus at the upper pole which was connected with the pelvis by a very small sinus.

Remarks.—It is rather unusual to see such slight ureteral changes when the kidney process has extended over a number of years.

SUMMARY.

1. By means of the cystoscopic examination we can almost always tell which kidney is affected in renal tuberculosis. The exception to this is when the tuberculous process is shut off from the kidney pelvis, or when the kidney excretes nothing at all through the ureter.

2. The extent of the lesion cannot be accurately determined by the cystoscopic examination, which must in all cases be supplemented by ureteral catheterism or urinary separation.

3. Aside from its rigidity the most typical changes in the ureteral orifice are, (a) tubercles around the orifice; (b) red granulations; (c) enlarged, thickened and ulcerated orifice.

4. A ureter which looks normal and which is contracting and excreting urine, indicates in the large majority of cases a kidney which is excreting normal urine as regards pus and tubercle bacilli, and has a normal functional capacity.

5. In some cases the diagnosis of tuberculosis can be made by means of the cystoscopy alone. This is of considerable value when tubercle bacilli are not found in the urine.

CYSTIC DISEASE OF THE BREAST.*

BY WILLIAM J. TAYLOR, M.D.,

OF PHILADELPHIA.

DURING the past few years I have had under my care 26 cases of disease of the female breast in which some form of cystic degeneration had occurred, and one case of cystic disease in a male breast. During the same period I have had 28 cases of primary carcinoma of the breast.

I have not included in this list certain other cases of disease of the breast, such as fibroma, adenofibroma, and sarcoma, nor some cases which I have seen in the practice of other surgeons and of whom I have no definite records.

Of these 26 cases of cystic disease, 13, or just 50 per cent., had undergone some form of carcinomatous degeneration at the time of operation. It will therefore be seen that of the whole number there were nearly as many cases of cystic disease as of primary carcinoma in the proportion of 26 to 28, and that of these 26 cases one-half showed unmistakable evidences of carcinomatous degeneration. Several of these had had cystic disease for many years, in one instance for 17 years, and finally at operation cancerous changes were found.

This patient, a trained nurse, was under my personal observation for six years, but would not listen to the question of operation. At times the breast would show distinct evidence of enlargement, and cysts could be easily palpated, while a short time afterwards all evidence of disease would disappear and the breast feel perfectly normal. This was so unusual that for two years, from 1902 to 1904, I made frequent diagrams for record which show that a tumor could be felt in one portion of the breast at one visit and entirely disappear at the next, while later it would reappear in a totally new position. This patient first noticed the breast swollen or lumpy in 1886, with

* Read before the Philadelphia Academy of Surgery, March 7, 1910.

various degrees of pain and discomfort for two years, when all signs of trouble ceased, and it was not until 1899, or eleven years afterwards, that she again had trouble with it. Again it became normal and remained so for three years, or until 1902. During 1902 and 1903, as I have just stated, she was under my personal observation, and it was then that the diagrams were made. Finally, in 1904, a distinct mass in the upper outer quadrant became pronounced, fairly dense but elastic, and the patient consented to operation.

Microscopic examination showed a cystic breast, and the wall of the largest cyst was carcinomatous. The report was cystadenofibroma with beginning hard adenocarcinoma.

Very fortunately she has had no recurrence and is well to-day, six years since the breast was removed.

Of the 13 cases in which carcinomatous degeneration had occurred, six had cystic disease of both breasts, and a double operation was performed. In five of these one breast was found to be carcinomatous and the other simple cystic disease, while in one case both breasts were carcinomatous. In two of these cases, an aunt and a niece, both breasts were cystic, one of each being carcinomatous, and there had been ten members of their immediate family afflicted with carcinoma in some of its various forms.

My object in presenting this short paper is to emphasize the fact that in my personal experience of 26 cases of cystic disease of the breast, 13 or just 50 per. cent., were carcinomatous at the time of operation. I wish to put on record in the strongest possible language that can be used, my belief that all forms of this disease are dangerous, and that certainly one-half of such breasts will sooner or later undergo degenerative changes which will threaten the life of the patient. I know that many writers speak as though cystic disease was a trivial affection and one which does not demand prompt surgical intervention, but this does not agree with my own experience. When a cystic breast which has remained quiescent for a period takes on renewed activity, it is almost certain to be carcinomatous.

Treatment.—At one time I was quite favorable to Dr. Warren's method of operating, by which the gland is turned up on the chest and a wedge-shaped piece taken out which should include the cysts. Certainly, in a few well-selected cases, where the cysts are few and the period of the disease early, this is sufficient. It permits of a thorough examination of the breast, and does not produce the mutilation which a total amputation of the breast entails. Many young women will consent to this who would absolutely refuse the more radical procedure. With increasing experience, however, and after careful study of the history of my cases, I am more and more disinclined to accept this method as in any way adequate to insure the safety of the woman who is so unfortunate as to possess a cystic breast. I now make it a rule never to perform this without having the permission of the patient to do a more radical and thorough operation if I find the disease more extensive than I had originally believed it to be.

In operating, the whole gland should be removed with a wide area of skin, all glandular and fatty tissue removed from the axilla, and the fascia of the pectoral muscle taken away. The muscle itself I do not as a rule remove unless the tissues of the breast appear macroscopically uncertain.

I am so confident of the value of the X-rays in destroying carcinomatous cells and in at least retarding a recurrence of the disease, that I believe they should always be used as a prophylactic measure. Administration by a competent man twice or three times a week until ten or twelve treatments have been given, this to be repeated in three months, and again in nine months, adds materially to the safety of the patient.

When malignant changes have occurred, I believe the use of the X-rays is imperative, and their use should never be omitted. In two of the cases in my series local recurrences took place several times, the primary operation having been performed by other surgeons, probably being insufficient in extent, and finally Beatson's operation, of ovariectomy, was done. One of these patients lived for 13 years. The other, upon whom I operated in September, 1901, is alive and per-

fectly well to-day. In this latter case the X-rays have been employed twice a year, while in the former case they were not.

I have purposely not gone into the pathological histories of these cases, but confined myself to the clinical aspect of the disease, because Dr. John Speese, in the paper which he read at the meeting of this Academy in November, 1909, has covered the ground admirably and fully.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY.

Stated Meeting, March 9, 1910.

The President, DR. ELLSWORTH ELIOT, JR., in the Chair.

NEURALGIA OF THE SECOND DIVISION OF THE FIFTH NERVE: KOCHER'S OPERATION.

DR. A. V. MOSCHCOWITZ presented a man, fifty-two years old, who had been under his observation since 1908. He gave the usual history and symptomatology of these cases. In June and July, 1907, he was under the care of Dr. Otto G. T. Kiliani and received four injections of alcohol without obtaining any relief whatsoever.

The patient was first operated on by Dr. Moschcowitz on February 25, 1908, the operation consisting of a division of the first and second branches of the fifth nerve at their exit from the supra-orbital and infra-orbital foramina, these openings being then plugged with silver buttons. Following this operation there was a cessation of the pain in the integumentary distribution of the nerves, but it had no effect upon the pain in the palatal and superior dental nerves. A few months later the third division of the nerve also became involved. As the patient refused a major operation, he was again operated on under local anæsthesia on February 5, 1909, the inferior dental nerve being exposed and divided at its exit from the mental foramen, and the foramen plugged with a silver button.

As was to be expected, the patient again experienced relief in the integumentary distribution of the nerve only, and he was subsequently re-admitted to the hospital, seeking relief for the pain, which he now referred particularly to the nerve originally involved, *i.e.*, the second division. Kocher's operation was done on October 25, 1909, and since then the patient had been entirely relieved of his pain. The time that had elapsed since the operation was of course too short to pronounce it a cure.

Dr. Moschcowitz said this was the first time he had performed

Kocher's operation, but he was very much impressed with the beautiful exposure it gave and the ease with which he was able to extract the entire nerve.

TRIGEMINAL NEURALGIA: HARTLEY-KRAUSE OPERATION.

DR. MOSCHCOWITZ also showed this case. The patient was a married woman, fifty-eight years old, who had been referred to him a little over three years ago with the typical symptoms of trigeminal neuralgia. In this case the pain was so exquisitely confined to the integumentary distribution of all three divisions that he looked upon it as an ideal one for a peripheral operation. This was done early in 1907, the three branches of the nerve being cut and the foramina plugged. This gave the patient complete relief for over a year. Then the pain recurred in the distribution of the nerve proximally to the silver plugs, and as the involvement was so extensive, the speaker said he advised an intracranial operation, his intention being to divide the sensory root only.

In connection with the operation itself, the following interesting points were observed: When the operation was commenced, the patient's pulse was 104 and the blood-pressure 155. There was absolutely no hemorrhage to speak of, yet the blood-pressure sank very rapidly, falling to 110 in seventeen minutes and to 85 in twenty-six minutes. This action of the blood-pressure almost decided him to complete the operation at a second sitting, but as the pulse continued of excellent quality, he completed the operation at once, but abandoned his original intention of dividing the sensory root only, and substituted for it an extirpation of the Gasserian ganglion, which, with the exposure he then had, was evidently of easier execution.

The patient was out of bed on the day following the operation, and made practically an uneventful recovery. The eye was protected by a watch-glass, and there was no resulting irritation of the cornea. Anæsthesia was complete, and there has been entire relief from pain up to the present time.

DR. ELLSWORTH ELIOT said he had had a single experience with the Kocher operation in a case of extreme neuralgia of the superior maxillary nerve. The patient was free from pain for a number of months; then it recurred, although it was not so intense as prior to the operation. A resection of the ganglion was advised, but the patient declined.

DUODENAL FISTULA FOLLOWING NEPHRECTOMY FOR STONE.

DR. JAMES M. HITZROT presented a married woman, forty-three years old, who was admitted to Bellevue Hospital on June 1, 1908, complaining of pains in the right lumbar region which had been present for the past three years. For the past six months she had been confined to bed with chills and fever; she had lost some weight, and her feet became swollen when she got out of bed. At varying intervals the urine had contained blood. There had been no urinary frequency; no colic; no radiation of the pain. On the day prior to her admission the pain became extreme in the right side, and she had a high fever, with chills.

Upon admission, examination showed a large perinephritic abscess, which was pointing near its centre. The patient was anæmic, and both feet were slightly swollen. Her temperature was 101; pulse, 120; respirations, 24. The urine contained numerous pus cells.

Under local anæsthesia the perinephritic abscess was opened, and more than a pint of pus was evacuated. No stones could be felt in the wound. The patient refused further treatment at the time, and left the hospital with a small discharging sinus. The pus proved sterile on culture.

The patient was re-admitted to Bellevue Hospital on July 26, 1909, complaining of a discharge from the sinus in her right side, which she said had lasted for two weeks. Since leaving the hospital she had had recurring attacks of aching pain in the right side, which became more severe just before the wound opened and discharged; since then she had felt better. Her general condition had slowly improved. Her urine had occasionally contained blood. An examination showed a discharge of pus in the region of the old scar, and a probe introduced into the sinus met with a hard, gritty resistance. The kidney itself was not palpable. There was some œdema of the feet and legs, but the patient's condition otherwise was fair. The urine had a specific gravity of 1018; it contained albumin and leucocytes, and granular and hyaline casts; no blood. A blood count showed 16,000 white cells, with 72 per cent. of polynuclears. A cystoscopic examination made by Dr. V. C. Thorne showed pus coming from the right ureter, the mouth of which was injected and swollen. The left ureter was normal, and the urine issuing from it was apparently clear.

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Operation, July 29, 1909.—The right kidney was exposed through an incision extending from the twelfth rib to the crest of the ilium, and was removed with considerable difficulty, on account of the dense perirenal adhesions. The perirenal scar tissue contained three or four free calculi. The pedicle was clamped, and the rather free oozing was controlled by gauze packing. This was removed on the fourth day, and the clamps were taken off on the following day. On the night of the sixth day there was a copious discharge from the wound; this continued, and on the following morning there was escape of clotted milk from the wound. The patient complained that the discharge burned her skin. It was acid and bile was found present in one test. There was no vomiting. Milk given by the mouth promptly appeared in the wound in the form of clots, and methylene blue, given by capsule *per os*, appeared in the wound within an hour after its ingestion (40 min., 35 min., 25 min., 60 min.).

Frequent saline irrigations were used to cleanse the wound and it was dressed and packed at regular intervals. The discharge began to grow less on the twelfth day, and the wound was then packed with gauze soaked in a one per cent. balsam of Peru in vaseline. On the twenty-second day methylene blue taken by the mouth no longer appeared in the wound, and the sinus healed completely after two months. Since then the patient had steadily improved.

In connection with this case, Dr. Hitzrot exhibited an X-ray picture taken prior to the nephrectomy, which showed the presence of seven stones in the kidney. The pathological report, furnished by Dr. Norris, showed that the kidney structure was almost completely destroyed, with only small areas of kidney tissue remaining in the dense scar tissue. A large, branching stone completely filled the pelvis and calices of the kidney.

DR. ELIOT asked whether the patient lost flesh during the interval that elapsed prior to the closure of the duodenal fistula, and also whether a gastro-enterostomy was suggested to hasten its closure. The speaker said that in one case of duodenal fistula that came under his observation, the lesion was the result of a perforation of an ulcer associated with an extensive abscess involving at least three-quarters of the peritoneal cavity which had been opened and drained. A duodenal fistula developed, and within a week or ten days there was a free discharge of duodenal

contents. Associated with this there was a slowly progressive loss of strength which finally precluded operative interference, and the patient died of exhaustion. In that instance, Dr. Eliot said, he afterwards regretted that he did not make an attempt to save the patient by an early gastro-enterostomy, although at the time it seemed to be contraindicated by the extensive suppurative peritonitis. Efforts were made to close the opening in the duodenum by pressure, as Dr. Hitzrot had done, but without success.

DR. HITZROT, replying to Dr. Eliot, said that Dr. John Rogers had suggested a gastro-enterostomy, but the patient was doing so well by the packing method that an operation was found unnecessary. She was fed on milk and milk sugar by rectum; and did not lose flesh materially during the 22 days that the fistula remained open.

RESULT FOLLOWING EXCISION OF FRACTURED CARPAL SCAPHOID AND DISLOCATED SEMILUNAR.

DR. HITZROT showed this case, together with X-ray pictures. The patient was a man, twenty-three years old, an acrobat, who was admitted to the New York Hospital accident ward about December 1, 1909, with the history of having fallen 10 feet on the previous day, striking the cement floor. As he fell, his left hand, which was in his overcoat pocket, received the brunt of the fall. He complained of a great deal of pain in the left wrist and was unable to bend it.

When Dr. Hitzrot first saw the patient, about three weeks later, the wrist was swollen. There was no active nor passive motion, and attempts at motion were painful. Pressure on the snuff-box was painful, as was pressure between the extensor tendons of the thumb and fingers. On the palmar surface, between the palmaris and flexor radialis tendons, there was a hard, bony mass which could not be moved by pressure; over the ulnar styloid there was some tenderness. An X-ray was taken, which showed a displaced semilunar, fracture of the scaphoid and of the styloid process of the ulna.

The patient entered the hospital in Dr. Alexander B. Johnson's service, on January 6, 1910, and on the following day Dr. Hitzrot made an incision two inches long from the base of the palm midway between the flexor carpi radialis and palmaris. The anterior annular ligament was then cut, and the tendons and

nerve drawn to the ulnar side of the hand. This exposed the displaced semilunar, with a small fragment of bone attached to its ulnar side. As the semilunar could not be replaced, it was removed, together with the proximal fragment of the scaphoid and the small fragment already mentioned, which after removal was found to have come from the anterior surface (at its edge) of the radius. The annular ligament was closed with catgut and the wound was closed without drainage.

The patient's recovery was uneventful. Baking the wrist was resorted to at the end of the first week, with massage and active motion. Dr. Irving D. Steinhardt took the patient to the Vanderbilt Clinic, where motion was continued by the use of the mechanical exerciser for that purpose. The wrist could now be moved, with but little limitation, in all directions. There was no pain, excepting over the ulnar styloid and in dorsal extension when lifting.

The patient stated at the meeting that he could now catch his partner on his extended hand without any pain and support him there.

INTESTINAL DIVERTICULITIS.

DR. JOHN A. HARTWELL presented the gross specimens, microscopical sections and lantern slides from 19 cases of intestinal diverticulitis collected by Dr. R. Cecil and himself. As the result of their study of these, they gave the following summary and conclusions:

All of the small intestinal diverticula were in close relation with the mesenteric line; none of those in the large intestine was so placed, the greatest number, eight cases, being found between a lateral tænia and the mesentery. Only one was found in the convex border of the intestine. In only one case was there any evidence that a venous congestion in the inferior mesenteric veins had been present during life while in eleven this was absent; in the remaining six, no information on this point was obtainable. This was in direct opposition to the finding of Grasser.

Evidence of the muscular coats being present in the wall of the diverticulum was found in every case except two. In some it was much thinned out, the large diverticula showing this thinning most markedly. This might be taken as proof that in their beginning all diverticula were of the true type, and that with their growth they took on the characteristics of the false type.

Summary of reported cases: Four cases showed symptoms for which they were operated. Three suffered from chronic symptoms, and all were cured by operation. One suffered from acute obstruction and was cured by operation. Eight specimens were obtained from autopsies on persons dying from causes not connected with the diverticula, and in none of them had any symptoms relative to this condition ever been present. The remaining six specimens were found in the museums, and no clinical nor post-mortem data were obtainable.

Of 13 cases in which the sex was given, 10 were females and 3 were males. The 2 youngest cases were six and seven years old, respectively. Three were under thirty years of age, and 6 were over fifty. The ages of those giving clinical symptoms were between twenty-two and forty-three, thus demonstrating that neither the diverticulum nor its inflammation is solely a disease of advanced life. Three cases out of 5 examined were found in infants. The least number of diverticula found in a given case was one, and the most was 33, with an average of about 10. In 7 cases the lesions involved the descending colon or the sigmoid, or both. Three involved the ascending colon or the cæcum, 2 the transverse colon, 2 were said to have involved the "colon," the particular section of the gut not being given, 4 involved the small intestine, 1 of which was in the duodenum, and 1 involved the wall of a Meckel's diverticulum.

Conclusions: (1) Diverticulum of the intestine is a common condition. (2) The large bowel is the most frequent site, particularly the descending colon and the sigmoid. Here their inflammation, producing clinical symptoms, is also common. (3) Children and young adults are subject both to the diverticulum and to the secondary changes in it. (4) A congenital defect in the intestinal wall of the colon could be proven, and this is the most important factor, etiologically, in the formation of diverticula of the large intestine, at least. (5) All diverticula are probably true in their incipency. The false characteristics are the result of their growth. (6) Diverticula undergo the same pathological changes as the appendix vermiformis, and give rise to much the same general symptoms. These pathological changes are not uncommon.

DR. JOHN F. ERDMANN said that a few weeks ago he operated on a man, forty-three years old, whose history dated back

four years, the symptoms pointing to a condition of chronic indigestion. Operation revealed one large diverticulum, about the size of a small hen's egg, and numerous small ones. This section of the sigmoid was removed with considerable difficulty, as it had turned over to the right side and was densely adherent to the mesentery of the small intestine. The patient made a good recovery.

In another case, which was supposed to be one of left-sided appendicular disease, the condition, upon operation, proved to be one of diverticulitis. That case was subsequently included in Dr. Mayo's group of six cases in a paper which was published in the *Journal of Surgery and Obstetrics*.

With reference to the presence of blood in the stools, Dr. Erdmann said that in the case he operated on recently the stools contained some blood, which was attributed to hemorrhoids. A proctoscopic examination in this case gave negative results.

DR. CHARLES H. PECK said that in one case of diverticulitis of the sigmoid that had come under his observation, the patient was a man, about sixty, who had a generalized peritonitis which was attributed to a ruptured appendix. He died on the fifth day of peritonitis and pneumonia, and the autopsy showed a large number of minute diverticula of about the same size, all grouped within ten or twelve inches of the length of the sigmoid. One of these had perforated; the rest were apparently not diseased, and none of them was large enough to admit a pea.

More recently, Dr. Peck said, in operating on a woman for a volvulus, he found several diverticula of the upper jejunum, all much larger than the one that had perforated in the fatal case that he had referred to above. They were pretty well pedunculated, and showed evidence of having been there for some time.

DR. HOWARD D. COLLINS said he had seen three cases of multiple hemorrhagic infarcts of the small intestine, about the size of a silver ten cent piece, and he suggested that in the repair of such lesions it might possibly lead to the weakening of the muscular structure of the gut and predispose to the formation of diverticula. In one of his cases, where the infarct was at the junction of the duodenum and jejunum, it finally perforated the gut, allowing the discharge of duodenal contents. As in the case shown by Dr. Hitzrot, the discharge was checked by packing.

DR. MOSCHCOWITZ said that since he showed the case of

diverticulitis to which Dr. Hartwell referred in his paper, he had had occasion to operate on another case. This was in a man of seventy-three years who was apparently suffering from peritonitis, and upon opening the abdomen, the peritonitis was traced to an abscess which had perforated, and which originated in the region of the sigmoid flexure. The man was in a wretched condition at the time of the operation, and nothing could be done beyond draining the abscess, which was suspected at the time of being a perforated diverticulitis. Death occurred on the fifth day, and the autopsy showed a number of diverticula of the sigmoid, one of which had perforated.

In addition to these two cases, Dr. Moschcowitz said, he had had occasion to operate on a third case of diverticulitis of the sigmoid, also with fatal issue, and on a fourth, which recovered. He also mentioned the case of an old lady whom he saw with Dr. Langmann some twelve or fourteen years ago. This patient died of a complication of conditions, particularly cirrhosis of the liver, and at the autopsy her colon was found studded with multiple diverticula, looking like rows of beads, and from 500 to 1000 in number.

Dr. Moschcowitz said that while the pathology of intestinal diverticulitis was readily understood, its pathogenesis was more interesting and obscure. From his own reading and study of the subject, particularly in connection with diverticula in other parts of the body, he was decidedly in favor of the view of Krause and Klebs, who claimed that the condition was a diverticulum or herniation of the mucous membrane along the course of the blood-vessels, and it could be readily understood that such lesions were most apt to occur at the points where the vessels perforated the muscularis, thus offering natural points of weakness.

DR. ELIOT reported the case of a man of fifty, who, without symptoms and without apparent cause, developed an abscess in the left abdomen, above the crest of the ilium. It was supposed to be due to a suppurating diverticulitis. Upon opening the abscess and exposing the distended colon, a suspicious hardness of the gut was discovered. A section of this was removed and examined, and proved to be an adenocarcinoma. The case was an illustration of the fact that now and then a carcinoma would undergo suppuration, with the development of an intraperitoneal or intramural abscess, such as occurred in diverticulitis.

Dr. Eliot said the case he had mentioned was the only one he had ever seen of carcinoma of the fixed position of the large intestine that had undergone suppuration.

DR. HARTWELL, in closing the discussion, said that Mayo had reported one case of carcinoma connected with a diverticulum. With reference to a perforating diverticulitis, such a case was reported in the *ANNALS OF SURGERY*, with peritonitis and death, and the autopsy showed an adenocarcinoma. An important point to bear in mind was that all perforating lesions of the large intestine or sigmoid were by no means diverticula. In one case seen at the Presbyterian Hospital the lesion proved not to be a diverticulitis, although no definite etiological factor could be found.

The question of the pathogenesis of diverticulitis was exceedingly interesting. Doubtless the blood-vessels, to a certain extent, determined the course along which these diverticula travelled, particularly in the small intestine, but in the large intestine there was no evidence of any such relation, nor did the diverticula develop anywhere near the mesenteric wall. Again, the mesentery did not show the presence of blood-vessels in close relation to the diverticula, and their etiology, in this section of the gut, at least, was still uncertain. Grasser's view was that they only followed the blood-vessels in cases where the spaces for the latter were in a dilated and weakened condition due to venous stasis. Diverticula differed so markedly in their structure, some having an exceedingly small neck communicating with the sac and others having a very large opening, that it was hard to believe that they all originated from the same condition. It was probable that in their formation different etiological factors were at work.

TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY.

Stated Meeting held March 7, 1910.

The President, DR. ROBERT E. LECONTE, in the Chair.

FRACTURE OF THE PATELLA TREATED BY SUBCUTANEOUS PURSE-STRING SUTURE.

DR. JOHN B. ROBERTS presented a man to demonstrate the result of the treatment of a fracture of the patella by a subcutaneous purse-string suture (Fig. 1).

He said that two or three times in discussions in regard to the suturing of the patella he had mentioned this method, but never found any one to believe in it but himself, so he had brought this man to prove how satisfactory it is both to the patient and to the operator. It can be done without general anæsthesia, although it is better to give ether, because then the muscles are fully relaxed, and one can press the fragments more closely together with the fingers. By rubbing them together when they are in apposition the edges of the capsule may be displaced from between the fragments. After getting them together, put the wire or string around the bone and then have a skiagraph taken. The apposition is apt to be a little imperfect, but the union becomes so good that for all practical purposes it is as good as the result obtained by the open operation.

This is not Barker's operation, for he passed the ligature around the bone in the sagittal plane, going through the joint and back under the skin over the top of the patella and tied. The method described is a purse-string suture in the coronal plane, going around the bone by passing through the ligamentum patellæ, catching the tendinomuscular tissues on both sides, and traversing the muscle just above the bone. It thus, when tied, draws the fragments together. It is satisfactory for a man who

does not like to give his patient too great a risk, and who is not afraid of aseptic subcutaneous work or of the string breaking.

It is wise to make four punctures through the skin and deep fasciæ at the points of exit of the needle, so that the ligature when tied may sink into the muscular structures and closely grasp the adjusted patellar fragments. The leg should be kept extended for three or four weeks. Then the ligature is removed by cutting the knot with fine pointed scissors and withdrawn. Later careful passive motion is made. Dr. Roberts found the method satisfactory for a number of years past. It is described in Jacobson's operative surgery as used by the speaker.

FIG. 1.

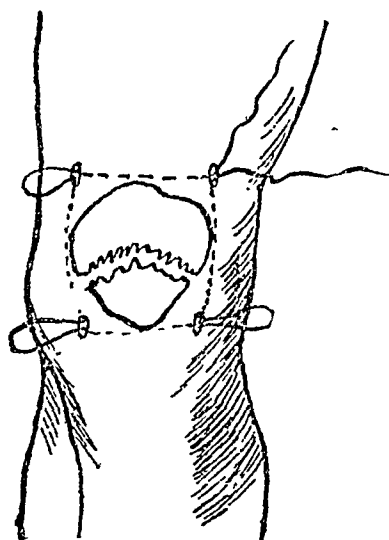


Diagram of purse-string method of treating transverse fracture of the patella.

DR. JOHN B. DEEVER said that he wished particularly to argue against the Barker operation in fractures of the patella. It is no better than a Malgaigne hook or plaster of Paris. If one aims to have bony union, the fragments of the capsule must be gotten rid of, and that is possible only by open operation which allows inspection and exact manipulation.

DR. HENRY R. WHARTON said that the operation done by Dr. Roberts is to his mind practically a modification of Barker's operation, which enjoyed a certain amount of popularity years ago, but which is seldom done at the present time. His reason for feeling that these operations are not satisfactory is that his

experience in opening the knee-joint in operating on fractures of the patella has shown him that in many cases the lower fragment is so drawn out of place that the articular surface is often turned upwards so that it comes in contact with the fractured surface of the upper fragment, and he also does not believe very close approximation can be got in the presence of a large blood-clot, which is another objection to this method of operation. Excepting in such a special case as the one presented, it is better to do the open operation for bringing the fragments into close approximation.

EXTENSIVE ANGIOMA OF THE UPPER EXTREMITY; VARICOSE VEINS SIMULATING A FEMORAL HERNIA.

Cases of the affections named were presented by DR. DUNCAN L. DESPARD.

DR. WILLIAM J. TAYLOR said that some years ago he reported an instance of a woman who had worn a truss for a number of years for what she had been told was a femoral hernia. She had no varicose veins anywhere. He operated on her and found varicose veins at the femoral ring. He ligated them and she did very well until a gastric ulcer set up mischief, and she finally died of a clot which he thought was the direct result of the gastric ulcer.

DR. JOHN H. GIBBON said he had seen two other cases, in addition to the one shown by Dr. Despard, of dilated veins in the femoral and inguinal regions, one of which was sent to the hospital as a case of hernia. Unless the veins were growing or were giving rise to a great deal of discomfort, he would not feel inclined to operate upon them. With regard to the case of the extensive angioma of the arm which Dr. Despard had shown, this patient was in the Pennsylvania Hospital nine years ago when the condition was not nearly so extensive, and at that time Dr. Harte tried the hot-water injections recommended by Wyeth. One of the interesting features in this case is the marked atrophy of the bones of the arm.

DR. HENRY R. WHARTON recalled a case at the Children's Hospital some years ago. The patient, an infant about one year of age, had an extensive angioma involving the shoulder and extending out into the pectoral muscles, which he attacked with the galvanocautery. A very fine Paquelin point was made and

applied, heated, at a number of points; the case was under treatment for several months and finally got well. Of course, if this had been allowed to go without treatment, it would probably have developed into a condition much like that of Dr. Despard's patient.

DR. A. P. C. ASHHURST, referring to the case of angioma, said that nearly four years ago he showed before the Academy a 12-year-old girl with an angioma quite as extensive in area but not nearly so large as this boy's, and the Fellows thought then that the prognosis was rather gloomy; but he had hunted her up recently and found that she is much better. The swelling is not so great when the arm hangs down, and she has developed very well, although the upper extremity is two inches shorter than the other one. Therefore, in the light of the improvement in his own case, he should give a more favorable prognosis in Dr. Despard's case and should be inclined to leave it absolutely alone. The boy says he can use this hand as well as the normal one, and experiences no handicap at his work.

VOLVULUS OF THE SIGMOID.

DR. EDWARD B. HODGE said that aside from the comparative rarity of sigmoid volvulus, this case is of interest from its history and from the size of the sigmoid.

J. K., aged 60 years, male, was admitted to the Presbyterian Hospital in November, 1909, on the fifth day of the attack. He had always been constipated, except for a few months six years ago, and again four years ago, when he had three to four very loose stools a day without pain. Two years ago he began to have attacks of partial obstruction three to four times a year. For two days there would be increasing tympanitis, no passage of flatus, slight colicky pain in left iliac fossa, radiating toward the umbilicus, and discharge of watery fluid from the rectum several times in the twenty-four hours. Then he would take a purge, and obtain relief after passage of very large, soft stool and much flatus; appetite good always.

Present attack was identical for two days, except that anorexia was present. There was no result from the usual purge on the third day. The distention became worse, with pain present but not increasing. On the fourth day he consulted his physician, who could find nothing pathological in the abdomen, and ordered a dose of castor oil. This was without effect, and the distention

steadily increased. On the fifth day his doctor gave him a two-quart enema, which was retained. Two hours later this was repeated, with the same result. Later another injection was returned as fast as given. Vomiting, which had been absent, now began, and he was brought to the hospital at 8 P.M.

His general condition was fair. Temperature 99.8°, pulse 120, respiration 24. There were extreme symmetrical distention, tense abdominal walls, through which nothing could be felt; no rigidity; slight general tenderness and dulness in the flanks, particularly the left. Peristalsis was absent. Rectal examination showed nothing but a much dilated rectum.

Left inguinal colostomy incision was made under ether. *Slightly distended small intestine* and descending colon presented. The obstruction was felt at the pelvic brim, and an enormously dilated sigmoid was lifted out. This was so large and the mesentery so long that the one loop of bowel had caused most of the distention. It extended to the liver and ensiform cartilage. The bowel was twisted from right to left through 360°. The twist was released, and bowel wall and mesentery found in good condition. There were no signs of adhesions or inflammation. With the loop hanging well over the edge of the table, a large quantity of gas and fluid was evacuated by incision. This was closed in the usual manner and the sigmoid returned to its proper place. The abdominal wall was closed by layer sutures without drainage. The patient's general condition was not thought good enough to warrant any procedures to prevent recurrence of the attack.

The patient made a smooth recovery and has been in excellent condition ever since.

Volvulus is generally credited with 3 to 4 per cent. of intestinal obstructions. Recent observations tend to give a higher percentage. While the present is the only instance of volvulus recorded at the Presbyterian Hospital in the last ten years among 61 intestinal obstructions, 57 operations at the Pennsylvania Hospital in the last five years give 7 of volvulus, 3 being of the sigmoid. This case is a fairly typical example of the recurring or subacute type. Careful attention to the history will often show symptoms extending over a term of years. This patient had six or eight attacks of partial twisting in two years. One of Bloodgood's¹ cases had thirty-two attacks in sixteen years.

¹ ANNALS OF SURGERY, 1909, XLIX, 161.

The important factors in etiology seem to be: (1) constipation; (2) long mesentery; (3) approximation of the foot-points of the loop; (4) adhesions; (5) age, 40 to 60; (6) male sex, 80 per cent. It is generally held that the drag of a sigmoid overloaded with gas and fæces elongates the mesentery of its pelvic portion, and so favors twisting. If, in addition, the foot-points of the loop are close together, volvulus is still more liable. The size and weight of these distended loops are hard to believe until seen. In his case he believed that most of the first two enemata passed into the sigmoid and were retained there, the weight then serving to increase the twist and make tighter the obstruction.

Why the proportion of male to female should be 4 to 1 is hard to understand, if constipation plays much of a rôle. Perhaps an elongated mesentery on the pelvic sigmoid is more frequent in the male, though the speaker could find no studies throwing any light on this or any other anatomic difference in the sexes.

High enemata in the knee-chest position will often relieve partial sigmoid volvulus. This failing, laparotomy, with untwisting of the volvulus and evacuation of the bowel by a rectal tube or incision, is demanded. To prevent recurrence, said to be usual, the sigmoid may be sutured to the lateral pelvis wall, or the mesentery folded on itself parallel to the bowel. Resection of the loop will be required for gangrene.

ULTIMATE RESULT OF EXCISION OF THE ELBOW-JOINT.

DR. H. R. WHARTON presented a woman, aged 50 years, whose left elbow-joint he excised fifteen years ago, for disability resulting from a fracture of the condyles and posterior dislocation of the bones of the forearm at the elbow of some months' standing. The patient did well after the operation and in a few months had good functional result. The functional result after fifteen years is good.

Dr. Wharton added that the principal point in obtaining a good result in excision of the elbow-joint is to remove the ends of the bones freely, and to begin passive motion not later than the third week. In excising the elbow-joint he also endeavored to retain the attachment of the triceps muscle to the ulna so that the patient will have more than gravity extension of the forearm. He divides the tendon of the triceps and divides the attachment

of the triceps to the olecranon and periosteum from the bone to a point below the bone section, and finally after the excision of the bones is completed unites the severed tendon by sutures. This procedure seems to give the patient better power of extension of the forearm.

DR. G. G. DAVIS, in commenting on excisions at the elbow, called attention to one point in the structure of the part. In fracture of the patella, the amount of separation is practically dependent upon the extent of the tear in the tissues on each side of the patella. The olecranon in the upper extremity is the homologue of the patella, and the olecranon, like the patella, has a fascia extending to the sides, which in a fracture of the olecranon will tend to hold it in place provided it is not too widely torn. The internal condyle lies close to the olecranon and between them runs the ulnar nerve and the fascia. There is a distinct fascia going from the side of the olecranon continuous with the tendon of the triceps and the internal condyle, but the distance is so short and this fascia so loose that it does not bear an important part in resections. When it comes to the outer surface of the joint from the external condyle to the side of the olecranon is a considerable distance, and if one traces down the tendon of the triceps he finds it inserts not only into the olecranon but passes as a broad sheet between the external condyle and the olecranon to be inserted into the upper one-fourth or one-third of the posterior surface of the radius, hence it is that when this is not divided in resections of the elbow-joint one frequently gets good results. It is obvious that one must expect a certain amount of weakening in the power, because an inch to an inch and a half of bone has been removed.

DR. JOHN H. JOPSON said that he had recently practised a method of preserving the attachment of the triceps in excision of the elbow, which he saw described some time since. It consists in sawing through the olecranon transversely, about one and a half inches below its tip, and turning the detached portion upward, with the tendon still attached. An excellent exposure of the joint is thus obtained. In traumatic cases where the olecranon is uninjured there is no necessity for removing any portion of it. In tuberculous cases the under surface if diseased can be removed by sawing off a slice. After concluding the operation of excision, the olecranon is dropped back and wired to the ulna.

PNEUMOCOCCIC PERITONITIS.

DR. HENRY R. WHARTON presented a girl, aged 8 years, who was admitted to the Presbyterian Hospital May 22, 1907, with the history that one week before her admission she suffered from abdominal pain, fever, and cough. She was seen by her physician, Dr. Ellinger, the day before her admission, who found her with a high temperature, pneumonia of the right lung, and a tender and distended abdomen.

When examined after admission her temperature was 103° , pulse 140, respiration 40. There was pneumonia of the right lung. The abdomen was moderately distended, rigid, and tender on pressure.

Under ether anæsthesia an incision was made over the region of the appendix, and when the peritoneum was opened a quantity of thick, yellow, odorless pus escaped. This purulent fluid seemed freely distributed through the abdomen and the pelvis. The appendix was normal in appearance; it was removed. Gauze and rubber drainage was introduced into the abdomen and into the pelvis, and the wound was partially closed by sutures.

An examination of the pus found at the time of opening the abdomen showed a pure culture of pneumococcus.

The day following the operation pneumonia of the left lung developed. The patient was critically ill for some weeks, and there was free discharge from the abdominal incision. The patient finally recovered and was discharged from the hospital in August. At the present time she is in good health.

Dr. Wharton remarked that pneumococcic peritonitis may exist as a primary or secondary affection. In the former case it is due to the primary idiopathic infection of the peritoneum by the pneumococcus; and in the latter arises from the infection of the peritoneum by the same organism in the course of pneumonia, pleurisy, or meningitis. A study of 74 cases of this affection by Savestre and Aubertin showed that the disease was primary, that is, the chief or only focus of pneumococcic infection, in 47 cases. In 140 cases of peritonitis examined bacteriologically, Netter found this form of infection only in two cases. Rollerston considers it a comparatively rare disease, although a number of cases have been reported by individual observers. Jansen has collected 106 cases of pneumococcic peritonitis.

Primary pneumococcic peritonitis is considered by Comly to be more frequent in children than in adults. Rollerston considers the disease primary in about one-half of the cases observed. All observers agree as to the greater frequency of the disease in childhood. Under 15 years of age the disease is much more commonly observed in girls than boys; according to Armand and Bowen, who collected 91 cases, the proportion was 3 to 1; while after this age its occurrence was equal in the two sexes.

When secondary, the disease may follow pneumonia, pleurisy, pneumococci gastro-enteritis, or appendicitis. The comparative rarity of the development of pneumococcic peritonitis in pneumonia is well shown by Rollerston's statistics: in 4454 cases of pneumonia, peritonitis was found only in 11 of the fatal cases, 0.025 per cent. The same authority points out the following channels through which the bacteria reach the peritoneum: (1) the blood stream; (2) stomach, intestines, and appendix; (3) pleura, through the diaphragm; (4) the Fallopian tubes.

While the disease may be primary or secondary, it is probable that hæmatogenic infection plays a most important part in its development.

Pneumococcic infection of other serous membranes may occur in addition to that of the peritoneum, especially in young children. The onset of the disease is sudden. The symptoms are abdominal pain, fever, and vomiting; these symptoms are so similar to those of acute appendicitis that the conditions are likely to be confounded. The acute symptoms may subside or become chronic, and the condition may resemble typhoid fever or tubercular peritonitis. Nutall describes two types of the affection: the acute, fulminating, diffused form, which is often fatal; and a form in which the onset is acute, but the progress is slow, which leads to the formation of a localized abscess. The lower abdomen is usually involved, and in a large majority of the cases this purulent collection becomes encysted, and the abscess occurs in the region of the umbilicus and tends to point. According to Armand and Bowen recovery followed in 86 per cent. of encysted cases and only in 14 per cent. of cases presenting the diffused form of the disease.

In view of the good results obtained in peritonitis by incision and drainage, it would seem wise to subject cases of pneumococcic peritonitis as early as possible to the same treatment. In

the diffused cases, in addition to incision and drainage, the Murphy method should be employed. In the encysted cases, incision and drainage only would be required. Nuttall recommends in the diffused form of this disease, if the diagnosis is made sufficiently early, the use of antipneumococcic serum and a trial of the vaccine method of treatment.

VALUE OF TENOTOMY IN SOME CASES OF FRACTURE OF TIBIA AND FIBULA.

DR. HENRY R. WHARTON said that in February, 1910, he was asked to see a lady in a town about 40 miles from Philadelphia, who had sustained a fracture of the tibia and fibula near the ankle-joint, in which it was found difficult to correct the deformity. The injury had occurred ten days before he saw her.

When he examined the patient, he found the limb much swollen, the foot flexed and drawn backward, simulating the deformity of a posterior dislocation of the ankle, and a marked projection of the lower end of the tibia above the ankle-joint.

The limb had been treated in a fracture-box, and there was a gangrenous spot the size of a dollar over the point of the heel. The deformity had been reduced on several occasions, but each time it had recurred.

She was sent to the Presbyterian Hospital the following day, and a skiagraph taken, which showed a fracture of the internal malleolus, a fracture of the lower end of the fibula, and a posterior displacement of the astragalus, which carried backward with it the foot and the fragments of the tibia and fibula.

After being etherized, it was found that by extension and manipulation only a partial correction of the deformity could be obtained. He therefore divided the tendo-Achillis subcutaneously, and was then able to reduce the fragments and correct the deformity completely. The limb was held in the corrected position and a plaster-of-Paris bandage applied, with provision for trapping over the gangrenous spot in the heel.

The patient did well after this, and was discharged from the hospital in eight weeks, with firm union and the bones in good position; she walked well and had normal motion at the ankle-joint.

Dr. Wharton said many cases of fracture of the tibia and fibula occur in the location of the one just reported, in which the

deformity is not very marked; but occasionally the deformity described above is met with. It is possible that in such cases there has been extensive laceration of the anterior tibial-tarsal ligament and lateral ligaments, in addition to the injury of the bones.

He had had in his own practice four or five cases of fracture of the tibia and fibula near the ankle-joint, where it was impossible to correct the deformity by ordinary methods, in which he had resorted to tenotomy of the tendo-Achillis to assist in the correction of the deformity. In all of these cases the result was eminently satisfactory, both as to the correction of the deformity and the subsequent use of the limb.

DR. G. G. DAVIS remarked that when the leg bones are broken, usually the upper fragment projects forward and the lower fragment is carried backward. The preponderance of muscles is posteriorly and renders this displacement marked and persistent. If one eliminates the muscles of the calf we have the muscles practically balanced. The muscles of the leg are practically of four sets, an anterior extensor set, comprising the anterior tibial, the extensor hallucis, and the extensor communis, and a posterior set, the posterior tibial and flexors of the toes and of the big toe; three abductors; the peronei muscles are on the outside and anteriorly and hardly take much part in flexion and extension, but the muscles of the calf, the gastrocnemius, soleus, and plantaris, have nothing to oppose them, therefore after dividing the tendo-Achillis there remain three muscles on the front and three on the back. The first thing to do in treating these displacements is to get rid of the action of these calf muscles, and by placing the leg in the Potts position (flexed on its outside) it is often easy to bring the foot into place. The use of adhesive plaster extension is likewise successful in some cases, but in a certain proportion of cases both these methods will fail, and then one is confronted with two propositions, one being to open up the fracture and bring the bones in apposition, wiring or fastening the fragments in place, and the other is the division of the tendo-Achillis. Of course, the division of the tendo-Achillis is the less dangerous of the two and it is very efficient. He had employed it for many years, but the question has always remained in his mind as to whether or not the division is accompanied by a permanent weakening of the functions of that limb. If one

operates by open section and deliberately replaces the bones, fastening them with wire, the leg is practically normal again. If one divides the tendo-Achillis, when the patient gets well his bones unite and he has a good looking limb, but to what extent do these calf muscles regain their original strength?

DR. ROBERT G. LECONTE agreed with Dr. Wharton that in the type of fracture which he showed, division of the tendo-Achillis is the expedient form of treatment. He had done it three or four times with good after results. There is always some atrophy of the calf muscles following, as there is after a traumatic rupture. In two cases he had seen of rupture of the tendo-Achillis from muscular violence, the limb in each instance has recovered perfectly from a stand-point of usefulness, although never coming back quite to the original measurements; so much so, that the patients are unaware now on which side the rupture occurred.

CALCULOUS CHOLECYSTITIS.

DR. JOHN H. GIRVIN reported the following cases:

CASE I.—A woman, age 40 years. Healthy until age of 17, when her child was born. Was never well after that. Seven years ago was operated for pyosalpingitis.

Present Illness.—Seven months ago had a severe attack of pain in epigastrium. Recovered in two weeks but soreness in right side continued for several weeks. No jaundice. Three weeks before admission a similar attack associated with severe vomiting, which improved under diet and treatment but did not clear up. This became much worse two days before admission to Presbyterian Hospital on January 12, 1910, at which time she was suffering severe pain. Had inspiratory catch. Upper abdomen very rigid and exquisitely tender. Three days later the pain had disappeared but some tenderness and rigidity remained, which gradually diminished until it was possible to outline a distended and tender gall-bladder.

Operation (January 22, 1910).—Vertical incision through edge of muscle. Gall-bladder exposed only after breaking up many adhesions. Incised and evacuated a clear thin fluid like bile, followed by thick creamy pus. At the beginning of the cystic duct was found a single stone the size of an ordinary marble which was removed with a curette. Uneventful recovery.

CASE II.—Woman, aged 37. Two years ago after typhoid

had a dull heavy pain in back which became severe and cramp-like and moved along the right costal margin to the region of the gall-bladder, where it became very severe, causing vomiting. Next day all pain gone but very sore and weak. Six or eight months later had a similar attack but more severe and longer. Up to admission patient has had five such attacks—each more severe and at shorter intervals. Last attack three weeks before admission. Never jaundiced; bowels moving by medicine since last attack and apparently normal.

When admitted there was no marked tenderness over gall-bladder region, and the gall-bladder could not be palpated.

Operation (February 5, 1910).—Vertical incision at edge of rectus. Liver seems freely movable downward, and under the edge of liver, bound up in a dense mass of old adhesions, was found a small thick-walled gall-bladder, to the lower edge of which was a dense adhesion to the bowel which resembled a fistulous tract but contained no opening. This was separated and only the necessary adhesions broken up. The gall-bladder was opened and a culture made of the clear non-purulent fluid. This showed a pure culture of the typhoid bacillus. A stone exactly like that in the previous case was removed from the same locality. Drainage tube inserted and an attempt made to invert edges, but this was very difficult on account of the thick walls of the gall-bladder and its very friable condition. Packing removed and a small gauze drain inserted to the region of the intestinal adhesion. Recovery uneventful but for bronchial irritation for first three or four days—temperature 101°.

CASE III.—Woman, aged 59 years. About two years ago struck her side on edge of table and was very sore for some time. After this, began to notice a swelling in region of the gall-bladder which was almost constantly sore. Had symptoms of indigestion but no vomiting and no distinct jaundice, although there is some cachexia. Her general health seemed to fail and she became so weak that she has been in bed for past three months. Came to city about two weeks ago and has since been under the care of Dr. Somerkamp, who made the diagnosis of gall-bladder disease.

Operation (January 5, 1910).—Incision was made along right rectus. Gall-bladder found enlarged and walls thickened; full of all size stones. One apparently in the common duct. It

required a large incision in the thick and friable walls to get out the large stone, which measured $1\frac{1}{2}$ inches long. Drained as in other cases. Operation prolonged and patient in poor condition and rather shocked. Color very poor. At end of twenty-four hours, temperature 102° , pulse poor, and not much drainage. January 7, slightly better but some evidence of congestion over base of right lung—later in day had an attack of heart failure but rallied. Lung condition progressed. Wound doing very well. Bowels moved freely and no distention. Lung and heart condition grew worse and she died at the end of two weeks from the heart and lung condition. She had been septic and with a myocarditis for several months and was in very bad condition at time of operation.

Dr. Girvin remarked as to diagnosis in these cases: In the first case the condition was plain. The local tenderness was unusually marked. From the literature it seems that the order of frequency of the bacterial cause of cholecystitis is as follows: (1) colon bacillus; (2) staphylococcus; (3) streptococcus; (4) typhoid; (5) pneumococcus, and after that a number of other varieties, but he was inclined to think that typhoid should be higher in the list. Cushing found that 10 in 31 cases had had typhoid. Flexner and Chiari found the typhoid bacillus in the bile in almost all cases dead from typhoid. It is interesting to note that the bacillus has been found in the gall-bladder operated upon seventeen or eighteen years after an attack of typhoid fever (Droba and Hunner). The infection of the gall-bladder may come either through the blood or from the intestines by the ducts (although this method has been questioned), but the source, while it may be anywhere in the body, is usually from the intestines.

In the second case the cause was plainly typhoid, and the picture was typical of a chronic cholecystitis. He was at a loss to suggest the cause in the third case and was not sure that there was not a malignant process associated with the chronic gall-stone disease. None of these cases has had jaundice.

As to the technic of operation, he had followed the incision used by Bevan parallel to the muscle. Pack off very carefully and do not break up old adhesions more than possible. He had drained with a fairly large rubber tube wrapped with gauze and rubber tissue and stitched to the inverted edges of the gall-

bladder with plain catgut. Drain into a sterile bottle (bile excoriates skin). He had usually tried to attach the peritoneum to the gall-bladder and closed with silkworm gut interrupted sutures, using small gauze drains at either side of the tube. The tube usually comes out very easily by the ninth or tenth day and the wound will close soon if the gall-bladder edges are inverted. This method of operation seems best adapted to this class of cases.

Each of these cases had impressed him with how easy it is to overlook a stone and how thorough and careful the search in the ducts should be. The complication of a recurrence of the symptoms from an overlooked stone is not uncommon.

DR. JOHN B. DEEVER said that gall-stones play an important rôle in connection with disease of the upper abdomen. But in more than 700 cases of acute intestinal obstruction he had met with but 2 cases of intestinal obstruction due to stone in the small bowel. It is his experience that more cases of obstruction of the cystic duct are caused by single than by multiple stones.

The typhoid bacillus plays an important part in the causation of cholecystitis. In his cases he had found that the colon bacillus had been more common than the typhoid bacillus; then the pyogenic organisms, and then the pneumococcus is the order of infection. The avenue of infection is most commonly through the portal circulation. He had had two interesting cases in this connection, bowel resection following femoral hernia; one in which the gall-bladder perforated, and both operated on for that condition. In these cases it was evident that the infection reached the gall-bladder through the portal circulation.

With regard to the question of recurrence, he had operated in many instances where it was problematical whether there was stone or not, and in practically all he found the recurrence of pain due to adhesions. He recalled one case in which a recurrence occurred in six weeks, jaundice, violent pain; he opened this patient's belly and all she had was adhesions; she is well at the present time. He had seen a number of instances of that character. He was glad that Dr. Girvin did not excise any of his gall-bladders. He excises a portion but rarely the whole organ. He was convinced, however, that men who take out the greatest number of gall-bladders are the men who see the smallest number of cases.

The question of technic as presented by Dr. Girvin is very good, but he could not endorse stitching the gall-bladder to the parietal peritoneum. He drops all his gall-bladders, putting in a purse-string suture, and inverting the edges. In some he placed a cigarette drain down to the gall-bladder.

Regarding drainage, he uses a cigarette drain in connection with the tube that is in the gall-bladder secured by purse-string suture. He elevates the foot of the patient's bed so as to confine the fluid to the field of operation. If there is oozing he passes a glass drainage tube down to the subhepatic fossa.

DR. JOHN H. JOPSON said that he saw all of the cases reported by Dr. Girvin. The most interesting was the case in which there was a history of typhoid fever two years previously. She had a very movable right kidney, and her attacks of pain had been attributed by one medical consultant to twisting of the pedicle. On operation the picture of chronic cholecystitis was typical, there being very firm adhesions to the bowel, one so dense and large that a fistulous communication with the intestine through it was looked for but none was present. In connection with the subject of cholecystitis, he could report a case of acute cholecystitis developing during convalescence from operation for appendiceal abscess, a rare complication, examples of which have been reported by H. R. Wharton and others. The patient was a woman, 55 years of age, with an abscess of appendiceal origin which had been drained and the appendix removed three weeks before. The onset of inflammation in the gall-bladder was acute, with pain, fever, and gastric disturbances, followed by development of a palpable swelling. The gall-bladder was drained a week later, four weeks after the operation for appendicitis, and contained much pus but no stones, and a pure culture of *Bacillus coli* was obtained. The patient recovered.

DR. JOHN B. SHOBER agreed with Dr. Girvin that the typhoid bacillus is responsible for a larger percentage of cases of calculous cholecystitis than is generally admitted.

If the nuclei of all the stones removed from any one case are carefully examined, pure cultures will be found in one or more stones and may be absent in all the others. Hence the importance of examining all the stones before a negative report can be made. He was convinced that many cases are overlooked when this rule is not observed. Such cultures are found many years after the occurrence of typhoid fever.

In operating upon these cases, the most important consideration is to secure free drainage not only of the gall-bladder but of the ducts. When this is properly accomplished by means of large calibre tubes, as a rule stones which were not removed or which were overlooked at the time of operation will pass later.

Experience had taught him to avoid cholecystectomy except in rare cases.

CYSTIC DISEASE OF THE BREAST.

DR. WILLIAM J. TAYLOR read a paper on "The Clinical Aspect of Cystic Disease of the Breast," for which see page 253.

DR. JOHN H. GIBBON said that he would practice complete removal of the breast only under the following circumstances: first, where cystic disease has existed for a long time; second, where there are multiple cysts; and third, where there is recurrence after operation. A single large cyst of short duration demands the Warren operation. It is only after these cysts have existed for a long time that the malignant change takes place. Thirteen out of twenty-six is an enormous percentage, and he would like to know, if possible, how long the cases which were not malignant had existed before operation, and how long the condition had existed in those which were found to be malignant, as this might help to prove the assertion regarding the duration. He had had only one case of malignant cyst, although many of cystic disease in the last few years. This one in which a malignant change took place was a case of multiple cysts of both breasts with complete removal of both breasts and no recurrence after three or four years. McGraw and Abbe recommended the evacuation of these cysts with an aspirating needle and he has done this in three cases without any recurrence. He would not, however, recommend this method of treatment.

DR. JOHN B. DEEVER thought every woman who had a tumor in the breast was a case for immediate operation. At the German Hospital, where from 75 to 100 cases a year are operated upon, he had often been surprised in cases which he considered simple cysts to have the pathologist's report come back stating that malignant change had taken place. Consequently in more recent years they had made it a rule to have every case examined immediately at the time of operation. In a certain percentage of cases the report comes back in five or six minutes of a malignant change, and then he removes the breast.

DR. JOHN SPEESE said that the very high per cent. of malignancy occurring in Dr. Taylor's cases was rather surprising in view of the fact that other writers have found that only 15 to 20 per cent. of the cases of chronic cystic mastitis become carcinomatous. He should be inclined, therefore, to think that Dr. Taylor's cases were seen at a more advanced stage of the disease or that he has included other varieties of disease in his collection. In reviewing the series of cases recently reported by Dr. Speese before the Academy, particular attention was paid to the possibility of a recurrence or malignant transformation in the cases in which plastic resection of the breast had been performed. In no instance had this complication arisen, so that he felt that the operation was safe in properly selected cases, and was especially desirable from the cosmetic stand-point, as the nipple and skin are preserved.

DR. G. G. ROSS said that he had on four occasions started out to remove a cyst by the so-called Warren operation and ended by taking out subcutaneously the whole gland, leaving just the fat, skin, and nipple. He found this very easy and perfectly practicable, and it left a good cosmetic result.

DR. WILLIAM L. RODMAN said that he had always held to the opinion that cystic disease of the breast, if not malignant in a large percentage of cases, was at least potentially malignant, and no one could say what is to be the end result in any case of cystic disease of the breast. No one even at the time of operation can tell macroscopically whether the cyst has undergone carcinomatous change. The former teaching, that if the contents are clear the chances are altogether in favor of benignancy, is far from accurate and should not be followed. Halsted has made this very clear; the thin-walled cysts with perfectly clear fluid are oftentimes the most malignant forms of cystic disease. The only safe way to treat such cases is to have an examination made at the time of operation. He had used the frozen section method for seventeen years and in all that time had known but two mistakes to be made, and one of them by a person of little experience with frozen sections, and he always employed and depended upon frozen sections in every doubtful case. He was in accord with Dr. Gibbon's attitude as to the probable malignancy in cases where there are multiple cysts. On this account the operation of Warren is not always to be advised; this is a

far more satisfactory operation where the cysts are single, but even where they are multiple and seem to be limited to a circumscribed portion of breast, one can afford to take the chance of the mistake being made by the frozen section and wait until a secondary report can be made. Halsted has, however, made this fact clear, that if one overlooks a malignant cyst at the time of the first operation and waits for a report in two or three weeks, the probabilities are that the whole wound has become inoculated; therefore such cysts oftentimes are the most malignant tumors to be found in the breast. He was very partial to Warren's operation; like all good things, however, it has limitations, and one should practise it only where there is a competent pathologist at hand to make a report.

As to the value of the X-rays following operations, he had changed his view entirely in recent years. Formerly he thought it perhaps best to supplement all operations by their use, but he never did so at the present time unless he thought the case a borderline one and that diseased tissue may have been left. He could see no reason why the X-rays should be used unless diseased tissue has been left, and in a complete operation this should not happen. Personally, he had not seen any abiding result from the use of X-rays in the case of carcinoma excepting in the superficial squamous epitheliomata which occur about the face and other parts of the skin. He had seen most excellent results follow the X-rays in sarcoma, not only of the soft tissue but in bones. In carcinomata the improvement has invariably been only temporary.

While he had recognized for years that the percentage of cases of cystic disease of the breast either primarily malignant or undergoing malignant change was a large one, he had not found it as high as reported by Dr. Taylor. This should make us most cautious in dealing with cysts in the breast.

DR. GEORGE P. MULLER emphasized the fact that the diffuse hyperplasia of the breast, commonly called chronic cystic mastitis, is a different disease from the malignant or cancer cysts. The previous speakers seemed to make no distinction between them, and if such distinction is not made he agreed with them that radical operation should be done in all cases of cystic disease of the breast. If one was familiar with the surgical pathology of the breast, and especially had had some years of experience in

the handling of specimens of this disease, checking up gross observations with microscopic examinations made from numerous places, one is able at the time of operation, in an occasional case, to determine whether or not the growth may be confidently considered to be benign. He, therefore, believed that radical operation should be the rule, but that occasionally it was possible to safely perform some such conservative operation as the plastic procedure described by Warren.

CORRESPONDENCE.

SUTURE OF THE RECURRENT LARYNGEAL NERVE.

EDITOR ANNALS OF SURGERY,

DEAR SIR: In the ANNALS OF SURGERY for April, 1910, I reported a case of suture of the recurrent laryngeal nerve. In this article occurs the following: "A thorough search of the literature in the library of the Surgeon-General's office, at Washington, has not revealed a single case of suture of this nerve in man. Consequently, the case reported below is apparently unique."

Dr. W. W. Keen, of Philadelphia, has kindly called my attention to the report of a case of suture of the left recurrent laryngeal. The report was made by Förderl (*Wien. klin. Woch.*, 1896, 1258) and is entitled "On Resection and Suture of the Trachea." Suture of the recurrent laryngeal nerve under such a title can easily be overlooked and if it had not been for the accuracy of Dr. Keen in keeping an index of such cases I doubt if I could have found this reference. Certainly it could not be reached by any of the ordinary methods of hunting up the literature. Förderl makes no point of the suture of the recurrent laryngeal, but speaks of it rather incidentally. The case was that of a boy with a cut throat. The trachea was completely severed. The patient came under the care of a Dr. Lähne who sutured the trachea, the recurrent laryngeal nerve, and the muscles. The technic of suturing the nerve is not mentioned except that the structures were sutured with silk. The anterior portion of the tracheal wound was not closed, and a canula was inserted. The wound healed well, but stenosis occurred and a low tracheotomy had to be done. After this, the results appeared satisfactory and recovery was complete in four weeks. The innervation of the recurrent laryngeal nerve was reported to have been complete four weeks after the injury.

It is certainly unusual to find complete regeneration of any motor nerve in such a short time as four weeks. However, without any criticism of the case reported by Förderl, suture of the

recurrent laryngeal as reported in my article might still be said to be unique, as in Förderl's case it was merely an incident in the repair of a cut throat, whereas in my case the operation was planned and undertaken for the sole purpose of restoring the function of the recurrent laryngeal. The conditions are similar to the ligation of the femoral artery in amputation of the thigh, and the ligation of the femoral in continuity. In the first instance, the ligation is an incident in the operation, in the second it is a distinct operation in itself with an entirely different technic.

Respectfully yours,

J. SHELTON HORSLEY.

RICHMOND, VA., April 27, 1910.

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ORIGINAL MEMOIRS.

A CONTRIBUTION TO THE SYMPTOMATOLOGY AND SURGICAL TREATMENT OF SPINAL CORD TUMORS.

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OF NEW YORK,

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AND

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OF NEW YORK,

Surgeon to Bellevue Hospital; Professor of Anatomy and Clinical Surgery
in Cornell University.

CLINICAL PAPER BY DR. HUNT.

Introduction.—It is now a little over twenty years since Gowers and Horsley described their classical case of tumor of the spinal cord with successful extirpation and recovery. The reports which followed during the next ten years were, on the whole, very encouraging. In the last decade, however, with a more exact knowledge of the symptomatology and an improved surgical technic, this field has become one of the most promising in neurological surgery.

In Starr's¹ contribution to this subject published in 1895, 123 cases of spinal cord tumor were analyzed, in 22 of which an extirpation of the growth was attempted; of this number 11

died soon after the operation, recovery from the paraplegia taking place in six cases only.

A few years later, Collins² analyzed 70 cases which had been recorded subsequent to the publication of Starr's statistics. Of these, 30 received surgical treatment, in 12 of which the result was successful, and in eight only partially successful. In 10 cases the result was unsuccessful or fatal. Among the 40 cases of this series in which no operation was attempted, the autopsy revealed an operable tumor which could have been removed in 14.

In the more recent contributions, the percentage of recoveries is even higher; Schultze,³ in 1903, recorded a series of seven cases of extramedullary tumor, in which extirpation of the tumor was attempted, with three recoveries. Two years later Oppenheim⁴ published three successful cases in a series of six operations; and Pearce Bailey⁵ in a recent paper reports six cases in which extirpation was attempted, with three recoveries, one doubtful case, and one death.

In Oppenheim's⁶ latest discussion of the surgery of spinal cord tumors (1907), the statement is made that recovery takes place in about 50 per cent. of the cases presenting a typical clinical picture of extramedullary growth. Our operative statistics of tumors having this localization are even more favorable and I am convinced that with greater precision in diagnosis and an improved surgical technic, they will eventually be much better.

The series of cases forming the basis of this paper represents my clinical experience in this field, during the past ten years. Thirteen cases in all are recorded, of which six were extramedullary neoplasms. Of this latter group, one died as the result of the operative procedure; one survived the operation for nearly a year, the growth eventually recurring; and the four remaining cases may be regarded as successful, all the patients making fair recoveries from their paralysis and after a considerable lapse of time showing no symptoms of recurrence. In five other cases, an exploratory laminectomy was performed, but the nature or localization of the growth pre-

cluded removal. In a recent case of intramedullary tumor of the cervical region, an exploratory operation was performed and the cord was punctured, with the evacuation of two drachms of cystic fluid. Of the remaining two cases, the diagnosis was confirmed at autopsy, and these are included as contributions to the symptomatology of the subject.

I wish to express my thanks to Professor Dana for the privilege of observing and reporting a number of these cases, as well as for his valuable aid in the problems of diagnosis and localization. I am also indebted to Dr. Joseph Fraenkel for the privilege of observing Case I and to Dr. Abrahamson for a similar courtesy in Case V. The operations, in eight of the cases, were performed by Dr. Woolsey, who will treat in detail the surgical aspects of this subject. In two cases, exploratory laminectomy was performed by Dr. Frank Hartley and in one case by Dr. Bern B. Gallaudet.

Remarks on the Symptomatology of Cord Tumors.—The symptomatology of tumors of the spinal cord is dependent upon the nature and localization of the growth, and the relation which it bears to the long axis and the surface of the cord. It may be laid down as a general rule, that any group of symptoms indicating a progressive focal lesion of the cord should suggest the possibility of neoplasm. This is all the more important as recent observations have shown that many important and characteristic symptoms of tumor may be absent during the entire course of the disease.

The clinical picture of tumor in this region generally begins with *localized pain* due to involvement of the vertebral column, meninges, or more especially, the posterior roots. The pain is followed, after a variable period of time, by symptoms of gradual compression of the cord (sensory and motor paralyses and sphincter disturbances).

With vertebral and extradural tumors, these symptoms, both radicular and medullary, are usually bilateral, often even in the initial stage, while with intradural growths a unilateral symptomatology is more frequent, this often persisting for a considerable period. Exceptions, however, occur to both of these general rules,

Root pains are important, both as general and localizing symptoms. They may persist for years before the appearance of any medullary symptoms, and during this time are the cause of frequent errors in diagnosis. When these pains are situated in the extremities, they are often mistaken for neuralgia, neuritis, and rheumatism; and when referred to the trunk, are sometimes regarded as gastralgia, gall-stones, angina pectoris, appendicitis, and other visceral affections. These root symptoms, so characteristic when present, may fail entirely, and errors in diagnosis may often be attributed to this cause.

A zone of *hyperæsthesia* corresponding to the upper level of the compression is often present, but is far from constant. When demonstrable it has a definite localizing value.

Rigidity of the vertebral column, with localized pain and tenderness, are very characteristic of tumors of the spinal column. Such vertebral symptoms may accompany also intra-vertebral growths, and, when well defined, may be of distinct localizing value. In my own experience, vertebral symptoms are usually absent in intraspinal growths. Changes in the percussion note at the affected level of the canal have also been noted, but I was unable to demonstrate this symptom in any of my cases.

Extra- and Intramedullary Tumors.—In my series of cases, the general diagnosis of tumor and the localization in the long axis of the cord for purposes of laminectomy have not presented serious obstacles. I have, on the contrary, had great difficulty in deciding whether a tumor was an intra- or extramedullary growth. It is well to remember that some forms of chronic myelitis, multiple sclerosis, and even the early stages of certain systemic diseases of the cord, may simulate very closely the symptomatology of tumor. A careful study of such cases will usually reveal the true nature of the affection, but when in doubt and when a differentiation cannot be made, the patient should always receive the benefit of the doubt and exploratory laminectomy be performed without undue delay. In this connection, the question of localized serous accumu-

lations within the meninges (meningeal cysts)⁷ is of importance; for while these cystic accumulations may occur primarily, producing the typical clinical picture of tumor, they occasionally accompany chronic affections of the cord and vertebra (Oppenheim⁸), and their evacuation in the course of an exploratory operation might be attended with beneficial results.

The differential diagnosis of intra- and extramedullary growths is often so difficult, that in many cases it is impossible to reach a definite conclusion. As the extramedullary tumor alone offers the hope of successful extirpation, the recognition of this group is most important. But here again, when the clinician is in doubt, exploration is indicated and should be undertaken before the disease has progressed too far. I have more than once had occasion to witness exploratory laminectomy in doubtful cases, in which, even if the tumor could have been removed, the cord was already irretrievably damaged.

An extramedullary tumor, when situated beneath the dura mater, usually first manifests its presence by *unilateral root pains*. These may persist for many years without other symptoms; but eventually evidences of unilateral compression of the cord follow (Brown-Séquard type of paralysis). When the tumor is situated on the anterior surface of the cord, progressive paraplegia may develop, and the root pains may be entirely absent or appear late in the course of the disease,—as in a case which I observed in conjunction with Dr. Fraenkel in the Montefiore Home. If the tumor is located posteriorly, the root pains may, from the first, have a bilateral distribution from pressure upon adjacent roots. If, however, it occupies a central position between the roots, a clinical picture of ataxic paraplegia may result from pressure upon the long tracts of the cord (Oppenheim). It is also of interest to know, that rarely the effects of pressure on the cord may be greatest on the side opposite the lesion.⁹

The pains which result from pressure upon the posterior roots are segmental in their distribution, and do not follow the course of the nerve trunks, as in true neuralgia, and the

tender points so characteristic of neuralgia are absent. When present, these segmental root pains are of the greatest value in determining the level of the lesion, and according to Bruns are to be referred to, *a compression of the segment from which the root springs, and not to pressure upon the root in its intraspinal course*, a clinical law which has an important bearing on localization. In central tumors (intramedullary) the root pains are either absent or comparatively insignificant, and this constitutes an important differential sign from the extramedullary growths. Exceptions are occasionally noted.

The clinical picture of intramedullary tumor resembles somewhat that of a subacute or chronic transverse myelitis. The tendency to extension of the symptoms in an upward direction is frequently observed, and is another distinguishing feature from growths without the cord. In extramedullary neoplasms, on the other hand, the course of the affection suggests that the tumor is growing in width, and not increasing in length,—a clinical fact emphasized by Oppenheim, and which I have had frequent opportunity to verify. In central tumors (gliosis and glioma), vasomotor and trophic disturbances are of frequent occurrence, as well as a spinal deformity without pain or tenderness (kypho-scoliosis). Very characteristic also is a homolateral dissociated anæsthesia of segmental distribution (posterior horn anæsthesia). In extramedullary growths, root pains and root anæsthesias are present on the side of the tumor, and a contralateral anæsthesia below the level of the lesion. A dissociated anæsthesia (loss of pain and temperature sense) cannot be regarded as characteristic of central tumors, and may be encountered in vertebral and extramedullary localizations as well. *I have observed, however, that the tactile sense, under these circumstances while present, is definitely obtunded when compared with a normal area, which in some cases serves to separate this form of sensory disturbance from the dissociated anæsthesia of the syringo-myelic type.*

Atrophic palsies occur both in central tumors with invasion of the anterior horns and in eccentric growths involving the

anterior roots, although atrophy dependent upon extensive longitudinal involvement of the cord and accompanied by fibrillary twitchings is very characteristic of the central tumors, especially if associated with a loss of pain and temperature sense, homolateral and of segmental distribution. Fibrillary twitchings may, however, accompany extradural tumors situated on the posterior aspect of the cord, as occurred in several of my cases.

Symptoms resulting from an extensive longitudinal involvement of the cord are usually indicative of central tumors (an exception is the diffuse sarcomatous infiltration of the meninges). *In this connection I desire to emphasize a symptom which I have repeatedly observed in cases of extramedullary tumor in the cervical region. This consists of a distinct girdle sensation, or constriction, situated at the umbilical level or in the lower thoracic zones.* A similar observation has been recorded by Lenander and Henschen.¹⁰ In all of my cases in which this symptom was present, it disappeared after the removal of the growth. I have also observed an abdominal girdle sensation complicating a central tumor of the upper cervical region, which disappeared after the evacuation of cystic fluid from the interior of the cord.

The presence of a girdle sensation in cervical tumor, both extra- and intramedullary, is in all probability caused by pressure and irritation of intraspinal tracts. They are of the same nature as the referred pains sometimes observed in the lower extremities, from irritation of sensory tracts by tumors situated in the higher levels of the cord. It is of importance that their occurrence in tumors of this region should be recognized, otherwise they may be assumed to indicate a much greater longitudinal invasion of the cord than really exists.

Localization in the Long Axis of the Cord.—In determining the level of the growth for purposes of laminectomy, I consider the initial root pains when present to be of the first importance.

These are usually so persistent and severe, that even if the

patient first comes under observation long after their disappearance, their original seat may, as a rule, be determined with certainty.

When pain is absent, other localizing signs must be depended upon, such as muscular atrophy, paræsthesia, and the upper level of objective sensory disturbances.

The disappearance of root pains, which have existed for a considerable time, is usually caused by degenerative atrophy of the compressed roots; in which event a radicular strip or patch of anæsthesia or hypæsthesia may usually be demonstrated. In this connection it is well to remember Sherrington's law of the overlapping of sensory distributions, so that two or more roots must suffer compression in order to produce a demonstrable objective sensory disturbance.

I have already spoken of Brun's law, which refers a root pain from tumor compression to the segment from which the root arises and not to the root, in its intraspinal course.

Hyperæsthesia may, however, be caused by irritation of the root, which arises from the segment just above the growth.

Symptoms indicating involvement of the anterior roots, such as atrophic palsies of the extremities, are also important as localizing signs, either alone or as more frequently happens in combination with posterior root symptoms. In tumors of the lower dorsal region there may be localized palsies of the abdominal wall with reaction of degeneration and dislocation of the umbilicus from the median line. With the onset of medullary compression, the highest level of the objective sensory disturbance becomes a very important sign, and in this connection a diminution of sensation (hypæsthesia and hypalgesia) is as significant as a more complete sensory loss.

When present, a definite area of spinal tenderness or deformity are most important as localizing factors, but should always, I believe, be considered in their relation to the purely neural symptoms, otherwise deception may result. I have more than once observed local tenderness and slight deformity in a region of the spine when the root and medullary symptoms clearly indicated a different level of the cord, and which was subsequently confirmed.

The percussion note is, in my experience, without value; it should, however, always be tested and may be of assistance.

The abolition of the tendon and skin reflexes is also important, but only in conjunction with other symptoms.

I have not found it of any great practical importance to determine the lower pole of the tumor; this is often difficult or impossible, as the compression of the cord above usually masks the root symptoms at a lower level. The eccentric or referred pains due to irritation of the intraspinal sensory tracts are of no localizing value, and unless their true nature is realized may give rise to error. The same is true of the girdle sensations, which I have observed so frequently at the waist level in intraspinal tumors of the cervical region.

REPORTS OF CASES.

CASE I.—Extramedullary tumor (endothelioma) of the lower cervical segments, with successful extirpation.

CASE II.—Extramedullary tumor (fibrosarcoma) at the eighth cervical and first dorsal segments, with successful extirpation.

CASE III.—Extradural tumor (fibrosarcoma) of the upper cervical region (second, third, and fourth cervical segments). Extirpation, followed by recurrence and second operation which was successful.

CASE IV.—Extramedullary tumor (fibrosarcoma) of the lower cervical and upper dorsal segments. Extirpation, patient dying three days after the operative procedure.

CASE V.—Extramedullary tumor (fibrosarcoma) at the tenth dorsal segment, with successful extirpation.

CASE VI.—Extramedullary tumor (fibrosarcoma) of the lumbosacral region. Extirpation, with relief of pain but recurrence of tumor within a year.

CASE VII.—Extramedullary tumor (neurofibroma) at the cervical segment; with autopsy.

CASE VIII.—Intramedullary tumor of the upper cervical region, with exploratory operation and evacuation of two drachms of cystic fluid from the interior of the cord.

CASE IX.—Intramedullary tumor in the cervical region, with exploratory laminectomy. Growth inoperable.

CASE X.—Sarcoma of the meninges in the upper dorsal region, with exploratory laminectomy. Inoperable growth.

CASE XI.—Sarcoma of the meninges in the lumbar region, with autopsy. Inoperable growth.

CASE XII.—Carcinoma of the spine, with compression of the spinal cord at the twelfth dorsal segment: exploratory operation.

CASE XIII.—Melanoma of the sacrum, with compression of the corda equina: exploratory operation.

CASE I (Summary).—*Extramedullary tumor of lower cervical segments successfully removed. Onset with pains in the back of the neck and left shoulder, later in the right. Duration of pains one year, followed by flaccid paralysis of the left arm, spastic paralysis of the left leg and dissociated anæsthesia of the opposite side below the level of the third rib. Pathological diagnosis of tumor, endothelioma. Nearly complete restoration of function. No recurrence after 7 years.*

History.—Mrs. S., aged thirty-one, married; no children, no miscarriages. A few months before the onset of present trouble she fell and injured right hip. In October, 1901, was seized with pains in back of neck, later extending into left shoulder, which were very severe and sometimes lancinating. Later the pains were also felt in right shoulder. Six months after the initial pains, sharp lancinations also felt in upper chest below clavicles. One year after pains had made their appearance the left arm became weak and the left leg stiff and awkward. These symptoms progressed gradually and she soon noticed that the right leg was insensitive to heat and cold. Of late there has been a disturbance of the vesical sphincter and a girdle sensation immediately above the umbilical level. She also has had paræsthesias of both arms, more marked in the left. She states that several months previously the neck had been quite stiff for a time and movements had increased the pain. This, however, disappeared and has not recurred since.

Examination (January 23, 1903).—The cranial nerves are normal. The pupils are equal and react normally. Movements of the neck are free. There is no abnormality of the spinal column. Sitting up and bending the head forward accentuates the girdle sensation at the umbilical level. Jarring of spine and deep pressure cause no pain. The paralysis of the left upper extremity is distributed as follows. There are normal movements

of abduction, external and internal rotation of the shoulder and of flexion and supination of the elbow. Adduction of the shoulder is diminished and there is paralysis of the movements of extension of the elbow, pronation, extension of the thumb and fingers, flexion of the wrist and fingers (with the exception of the flexor sublimis digitorum, which is weak) and of the intrinsic muscles of the hand. There is well marked atrophy of the paralyzed muscles, but no fibrillary twitchings. The circumference of the left arm and forearm is half an inch less than on the right side. No oculopupillary symptoms.

Sensations.—On the entire right side below the level of the third rib anteriorly and the fourth dorsal spine posteriorly there is complete loss of pain and temperature sense, with preservation of the tactile sensibility (dissociated anæsthesia). Corresponding to the upper limit of this anæsthesia there is a hyperæsthetic band which is present on both sides of the trunk. There is a slight but distinct tactile disturbance along the inner side of the left arm and forearm. The deep sensibility of the fingers of the left hand is absent, but in the lower extremities the articular sense of the toes is preserved. The tendon reflexes of the lower extremities are exaggerated, more especially on the left side, which is spastic and in which ankle clonus is present. Babinski reflex present on both sides.

Surgical History.—She was referred for operation by Dr. Joseph Fraenkel of this city who diagnosed and localized the tumor. The operation was performed February 2, 1903, under ether anæsthesia, with the patient in a prone Sims' position on the left side. The spines and laminæ of the fourth to the seventh (inclusive) cervical vertebræ were removed by bone cutting forceps and a rongeur respectively. There was absence of pulsation in the lower part of the dura exposed. Median incision of the dura. Gauze was inserted between the dura and the cord at the cranial side of the opening which checked the troublesome flow of cerebrospinal fluid. At first nothing was seen except some bulging of the cord opposite the sixth lamina. Here a probe encountered resistance on the left side, where, pressing the cord to the right, a dark bluish prominence was seen anterior to the posterior nerve roots and extending anteriorly. Two posterior nerve roots were cut central to the root ganglia to expose the tumor. After dividing its capsule along the curved

line where it was apparently continuous with the pia, the tumor was fairly easily removed by blunt dissection. The tumor was apparently attached at one point to the pia. It measured 2 cm. in length by $1\frac{3}{4}$ cm. in width and $1\frac{1}{4}$ cm. in thickness. The dura was sutured with fine gut, the muscles and aponeurosis with chromic gut and the skin with silk. A cigarette drain was inserted to the dura at the lower angle which was removed two days later.

Postoperative History.—After operation the paralysis of the left side was somewhat increased, and there was some weakness of the right side, which cleared up in about ten days. She complained of paræsthesia (prickling), particularly in the upper extremities, and profuse perspiration of the face and neck was very annoying. Healing occurred *per primam*. There was no improvement for two weeks except the disappearance of the paræsthesia and sweating, and the immediate disappearance of the root pains.

On March 23, 1903, there was no demonstrable anæsthesia corresponding to the posterior roots severed at the time of operation; there had, however, been some paræsthesia which had practically disappeared. Since then steady improvement for a year or two. Motion returned first in the right and then in the left leg. Six years after the operation there remained only a slight weakness of the left hand. The tumor was an endothelioma (Prof. Ewing).

Remarks on Diagnosis and Localization.—The diagnosis of tumor was based upon the onset with lancinating pains, at first unilateral, and always more severe upon the left side, atrophic paralysis of the muscles of the left arm (lower arm type), and the symptoms of progressive unilateral compression of the cord (Brown-Séquard type). The absence of rigidity and tenderness of the spine was in favor of an intradural growth. Of especial interest was the presence of a well-defined dissociated anæsthesia upon the right side of the body below the level of the lesion, which gave rise to some uncertainty as to the intra- or extramedullary seat of the growth. It is possible that the localization of the tumor on the lateral

surface of the cord in this case by pressure upon Gowers's tract was responsible for the dissociation of sensibility. The duration and severity of the root pains preceding the compression of the cord were in favor of extramedullary growth. Of especial interest was the presence of a girdle sensation at the umbilical level. This association Dr. Fraenkel and I had observed previously in a case of extramedullary tumor on the anterior surface of the cord in the cervical region, so that we were rather inclined to regard it in this case as possessing some significance as an extramedullary symptom. Since then, I have observed this symptom in central tumor in the cervical region. The atrophic paralysis of the arm was attributed to compression of the anterior roots of the sixth, seventh, and eighth cervical, and first dorsal segments. It is interesting to note that oculopupillary symptoms were absent, although the intrinsic muscles of the hands were paralyzed and tactile disturbances were present along the inner side of the arm.

CASE II (Summary).—*Extramedullary tumor at the eighth cervical and first dorsal segments, successfully removed. Onset with pains in the back of the neck, the upper portion of the chest and the inner side of the right arm, followed seven years later by similar pains in the corresponding distribution on the left side. Duration of root pains before the appearance of spinal cord compression about ten years. These consisted of weakness of right hand and forearm with atrophy, spastic paralysis of the right leg, and tactile, pain and temperature disturbances below the level of the third rib, more marked on the left side. Pathological diagnosis—fibrosarcoma. Partial restoration of function. No recurrence after five and one-half years.*

History.—Mr. W. M., age forty-five, manufacturer, single, was admitted to the Presbyterian Hospital September 6, 1904. He is a man of moderate habits. No history of venereal disease or trauma. The present illness began twelve years ago with neuralgic pains in the upper portion of the right side of the chest, just below the clavicle, and along the inner side of the right arm. These pains continued with varying intermissions up to the present time. They are described as intensely neuralgic, somewhat like a toothache in character. Seven years later

pains of the same character made their appearance along the inner side of the left arm, as well as the upper portion of the left side of the chest. During this entire time there were no paræsthesia and no weakness of the arms, and he was treated for rheumatism and neuralgia without success. When the pains appeared upon the left side their intensity diminished somewhat on the right. They were often of a throbbing character. For the past year he has had a girdle sensation below the margin of the ribs, and for the same length of time has been impotent and very constipated. He has had a weakness of the vesical sphincter for the past six months and some uncertainty of the rectal sphincter. The girdle sensation is one of a feeling of pressure which comes on at night but has usually disappeared by morning after sleeping. It is increased in the sitting posture and disappears when standing or walking. In July, 1903, while in swimming he noticed that the right leg felt heavy and a little stiff, and this has been growing progressively worse. Occasionally he has paræsthesia of the feet, more especially of the right. He says that during the past week the neck has occasionally felt somewhat sore and stiff. This he had not noticed previously.

Examination (August 18, 1904).—Patient can stand and walk, but he drags the right leg which is distinctly spastic; and there is a marked Romberg symptom. Cranial nerves are normal. Pupils are equal and reactions present. The movements of the neck are quite free and cause no pain. There is no tenderness on jarring or direct pressure along the spine. There is a distinct weakness of the flexors and extensors of the right forearm, with slight atrophy along the ulnar sides of both forearms and in the intrinsic muscles of the right hand. Fibrillary twitchings are present in the intrinsic muscles of the hands, inner side of the forearms and the extensors of the forearms and triceps.

Sensations.—The tactile sense is practically abolished below the third rib anteriorly and the fourth dorsal spine posteriorly, as well as along the ulnar sides of the forearms. The pain and temperature sense are very much diminished below the nipples, more especially of the left leg. The deep sensibility of the right lower extremity is very much disturbed. There is a loss of pain and temperature sense along the inner side of the right

arm and forearm and a diminution of the pain sense along the inner side of the left arm. There is slight obtunding of the tactile sense along the ulnar sides of both hands. No hyperæsthesia. There is no ataxia of the upper extremities and the arm jerks are present. The abdominal and cremasteric reflexes are absent. The electrical responses in the intrinsic muscles in the hands and in the forearm to both faradic and galvanic currents are practically normal. The right lower extremity is weak in all segments. In the left there is good power but weaker than normal. The tendon reflexes are exaggerated on both sides, more especially the right. Ankle clonus and Babinski are present on both sides.

Surgical History.—Operation September 7, 1904. Anæsthesia, gas and ether. In a prone Sims' position on the left side, a median incision was made from the second thoracic to about the fourth cervical spine. The spines and laminae of the sixth and seventh cervical and the first dorsal vertebræ were removed. The dura did not pulsate and appeared swollen. There was no spurting of the cerebrospinal fluid until the incision had been carried above the swollen area. On opening the dura, an area firmer and darker than normal was disclosed beneath the seventh lamina. After dividing many layers of arachnoid and a thin bridge of what appeared to be nerve tissue, a cystic cavity was opened disclosing in it a tumor on the right posterior aspect of the cord, extending down beneath the first thoracic lamina. On removal by blunt dissection it measured 3.7 cm. long by 12 x 6 mm. broad. The wound was closed and drained as in Case I.

Postoperative History.—The sutures were removed on eighth day, primary union. Not long afterwards the skin opened up down to the fascia. A few days after the operation there was a free discharge of clear cerebrospinal fluid from the site of the drain until it was checked by the pressure of a pad. It ceased after eighteen days. For the first twenty-four hours the patient was not on an air bed, and notwithstanding the shortness of this period a shallow bed-sore subsequently developed over the sacrum and on each heel in spite of careful nursing. After operation the power of the right leg was completely lost; that of the left leg partly so, and the arms were very weak. The paralysis gradually cleared up so that by the end of the third week the arms were freely movable, though the legs improved more slowly.

There was also pain and painful twitchings in the legs and arms, which lasted between two and three weeks, gradually diminishing. September 10 there was sensitiveness to noises and light and distinct oculopupillary symptoms in the right eye. He was catheterized for the first week. There was no increase of the anæsthesia. Much of the time for the first week he was irrational and delirious. A week after operation he was free from root pains. A peripheral peroneal palsy of the left leg was discovered, due to pressure on the operating table or during the early postoperative period when he was paralyzed. The improvement in the lower extremities was slow and steady, and the peroneal paralysis cleared up. He regained sphincteric control. Five years after operation (1909) there is no sign of recurrence, he has no pain and walks with a cane. The right leg is weak and spastic. The microscopic diagnosis of the tumor was "fibrosarcoma, vessels fairly numerous" (Path. Lab. Presbyterian Hospital).

Remarks on Symptomatology.—This case is of unusual interest because of the long duration (ten years) of the posterior root pains. For seven years neuralgic pains were confined to the inner side of the right arm and the upper segments of the right side of the chest, without any weakness or numbness of the extremity. As the pains appeared upon the left side in a corresponding distribution, they diminished in intensity on the right side. This diminution was evidently due to destruction of the root fibres, as objective sensory disturbances were demonstrable along the inner side of the arm. The symptoms of cord compression appeared after ten years of neuralgic pains, and were predominant upon the right side, as was evidenced by the greater weakness and spasticity of the right leg and loss of the deep sensibility of the lower extremity, and the greater anæsthesia upon the opposite side of the body. That fibrillary twitchings in the muscles of the right hand and forearm may be present in extramedullary tumor situated on the posterolateral aspect of the cord, is interesting as it might give rise to uncertainty in regard to the seat of the growth. Twitchings of this character are commonly associ-

ated with irritation and degeneration of the anterior horn cells of the spinal cord, and are therefore a common symptom in central tumors. It is possible that the long duration of pain in this case may reflexly have induced an irritable state of the anterior horn cells, with consequent fibrillations. The atrophy which was present shows, however, that the anterior roots must also have suffered from pressure. In this case also a girdle sensation was present in the lower thoracic zones, which disappeared after extirpation of the tumor. This sensory symptom, referable to a much lower level than that of the lesion itself, is in all probability an eccentric or referred sensory symptom from irritation of intraspinal tracts. Although the first dorsal segment of the cord was the seat of compression, oculopupillary symptoms were not observed until after the operative procedure.

CASE III (Summary).—*Extramedullary tumor of the cervical region (third, fourth, and fifth segments). Operation in two stages. Successful removal of tumor mass. Recurrence in ten months. Second operation with removal of growth, followed by recovery with fair restoration of function. No recurrence after four and a half years. Symptomatology consisted of pains in the neck and shoulders with rigidity, followed two years later by symptoms of compression of cord, paralyses of the arms and legs and mild sensory disturbances. Pathological diagnosis—fibrosarcoma.*

Mrs. C. C., aged thirty-one, was admitted to the Presbyterian Hospital Oct. 27, 1904. She was a patient of Dr. Max Mailhouse, of New Haven, Conn., whose diagnosis and localization of the tumor was confirmed by Dr. C. L. Dana who saw her in consultation. She has had one child, no miscarriages. No history of trauma.

History.—In January, 1902, she was seized with pains in the back of the neck, radiating into the left shoulder. This pain was severe but not constant and during the paroxysms the head would be drawn down toward the left shoulder, assuming somewhat the attitude in wry neck. These pains would come and go, sometimes lasting two or three months, then disappearing for a time, the longest interval having been three months. Even

during this time she was conscious of slight pain in the post-cervical region. She had no pain anteriorly in the cervical region and none in the arms. In January, 1904, there developed numbness in the fingers which gradually passed up the inner side of the left arm. This was soon followed by a weakness in the left hand and shoulder. In March, 1904, the left leg became weak and stiff and has been getting gradually worse. The right leg is also weak, but much less so than the left. At night she is subject to spasmodic contractions of the muscles of the arms and legs. Sometimes all four extremities contract simultaneously and are drawn up together in a flexion attitude. In September, 1904, she experienced difficulty in micturition and for the past few days catheterization is necessary. In August the numbness appeared in the fingers of the right hand. This also was followed by weakness, especially in the movements of the shoulder. Since June, 1904, there is a girdle sensation in the epigastric region, which is constant. There is a transient girdle sensation around the breast, and rarely around the hips. The epigastric girdle is accentuated in the recumbent posture and on standing. It is also increased on turning the head toward the extreme right.

Examination (October 29, 1904).—Cranial nerves are normal. The left pupil is somewhat wider than the right but the reactions are normal. There is no ptosis and no enophthalmos. There is well marked rigidity of the posterior muscles of the neck so that the head cannot be brought forward. Movements of the head to the right are also restricted owing to the rigidity, not however toward the left. Backward movements are free. The left upper extremity, except for slight movements in the index finger, is practically powerless. In the right arm slight movement is possible in all segments, but the power is very much diminished. The excursions of the intercostal movement are also diminished. The diaphragmatic breathing is normal. Both lower extremities are paretic, especially the left, which is spastic with ankle clonus. The Babinski reflex is present on both sides. The epigastric reflexes are absent.

Sensation.—The tactile sensation is slightly disturbed over both upper extremities and the trunk, below the fourth dorsal spine, although no definite areas of anæsthesia can be made out. There is, however, an anæsthetic patch posteriorly over the upper portion of the left scapula. Pain and temperature sense are well

preserved over the arms, trunk and lower extremities. There is a band of hyperæsthesia on a level with the clavicles and another on a level with the nipples. Except for the rigidity and some tenderness on pressure of the neck, no abnormality of the spinal column could be detected.

The general condition was poor, the patient having eaten very little for the past few weeks. The diagnosis was made of an extradural tumor at the sixth and seventh cervical segments.

Surgical History.—Operation October 29, 1904, under gas and ether anæsthesia. The spines and laminae of the fourth, fifth, and sixth cervical vertebræ were removed, exposing an oval extradural, encapsulated tumor 3×1.5 cm., on the left postero-lateral aspect of the dura, opposite the fourth lamina and extending up under the third. The capsule, very adherent to the theca, was opened, disclosing an enucleable tumor, but at this stage the pulse and then the respiration suddenly failed. Artificial respiration and the intravenous infusion of 1000 c.c. of normal salt solution were employed and the patient reacted well to stimulation. The wound was temporarily packed and brought together by a few sutures. Stimulating and nutritive enemata for the next forty-two hours brought the patient into better condition than before the operation.

October 31 the operation was completed. The wound was reopened, part of the third cervical lamina was removed, and the tumor was removed piecemeal by blunt and sharp dissection. The oozing of blood was troublesome and was controlled by hot packing. The tumor seemed to spring from the dura in which a small opening was made, where the capsule was most adherent to it. This was closed by catgut suture. Wound closed as in previous cases. The condition of the patient remained good throughout the operation.

Postoperative History.—About the second day after the last operation she began to move the left hand. Power of motion improved rapidly and by the fourth day, motion, except in the left upper extremity, was nearly normal. By the fourteenth day, when she left the hospital, motion was normal except in the left upper extremity in which all but the finer movements were performed slowly. Pain in the extremities and sudden sharp pain in the wound was severe at first, but on the fourth day after operation it began to diminish, and was practically gone by the

thirteenth day. Urination was involuntary for a few days after operation and catheterization was employed. There were no oculopupillary symptoms (the left pupil is still a little wider than the right). The wound healed primarily. She made a practically complete recovery. The tumor was a fibrosarcoma.

A short time after her discharge from the hospital, November 13, 1904, she was practically well, except for stiffness in the left shoulder, and in January, 1905, the adhesions were broken up under anæsthesia and the arm restored almost to normal. There was no pain except occasional darts up and down the neck. Some stiffness of the neck always persisted.

In August, 1905, the first symptoms of recurrence appeared, consisting of pains in the neck and an aching pain in both hands. This was soon followed by weakness of both arms and legs, which gradually progressed. The girdle sensation in the lower thoracic zone reappeared. The symptoms have been symmetrical from the first and gradually progressive.

Examination (October 20, 1905).—Patient can stand and walk without assistance. The arms are weak in all segments, the right more than the left. Movements of the neck are somewhat restricted by rigidity. No ataxia of the arms. Tendon reflexes of the upper and lower extremities are all exaggerated. There is patella clonus on both sides, no ankle clonus. Babinski reflex on both sides. Abdominal reflexes faintly present. Superficial sensations of the trunk and extremities are normal, as well as the deep sensibility of the lower extremities. Pupils are equal. No vesical disturbances. There is a tender point about one and a half inches above the vertebra prominens. The general condition is far better than it was a year ago.

Surgical History.—Operation October 27, 1905, under gas and ether anæsthesia. Incision to the side of the old scar. The seventh cervical laminæ were removed to determine the level of the dura, which was covered by scar tissue above. The latter was readily separated from the dura to the upper end of the old laminectomy opening. The cord appeared flattened on the left side and on careful dissection a tumor 5 x 2 cm. was exposed on the left lateral aspect of the cord. This was removed piecemeal. It was well encapsulated, at least in part, and the capsule on the side toward the dura was removed cleanly, with a resulting

tear of the dura, which allowed the escape of considerable cerebrospinal fluid and was sutured. The tumor filled the left half of the canal extending out into two or more intervertebral foraminæ, where it was uncertain whether the tumor was entirely removed. Two or three nerve roots were exposed in the dissection but were apparently uninvolved and unharmed, though superficially scraped. The tumor extended no higher than before but somewhat lower. Wound closure as before, except that several silkworm gut retention sutures were employed, to be left in twelve to fourteen days to avoid the opening up of the wound as in Cases II and V. There was some postoperative shock but she responded to stimulation.

Postoperative History.—There was considerable paralysis of all extremities after operation. She soon began to move the right leg and a little later all the extremities, but recovery was much slower than after the first operation. Considerable pain was complained of in the legs and some in the neck. She sat up November 10, and went home November 12, when both lower extremities were moved well, the right arm was moved freely but was weak, while there was only slight motion in the left arm, which, however, was steadily but slowly improving. The microscopic diagnosis was the same as before, fibrosarcoma.

February 3, 1906: Recovery has been very slow, but has been more noticeable the past two weeks. She can walk with some assistance. The left side is still very weak and she has not yet regained the use of the left hand.

May 23, 1906: The gait has improved so that she walks very well, and can even stand on the left foot alone. There is still ankle-clonus and exaggerated knee jerks on both sides. The left arm remains spastic and paretic with flexion of the fingers, and she can do little with the left hand. No evidence of recurrence as yet. In view of the first recurrence, a bad prognosis was given, but in this we were wrong, for on November 3, 1909, four years after the second operation, Dr. Mailhouse writes, "Mrs. C. is practically well. She does her own housework and marketing, and goes out daily. She still presents evidence of the degeneration of the pyramidal tracts, produced by the long duration of the disease prior to operation, in a spastic condition of the left arm and leg and carries her head stiffly."

Remarks on Symptomatology.—In this case root pains preceded the onset of symptoms indicating medullary compression, by a period of two years. The pains were in the nuchal region and were bilateral, and when severe, extended into the left shoulder. Very interesting and very suggestive of extradural growth was the accompanying rigidity of the posterior muscles of the neck and the wry-neck attitude during the paroxysms of pain. It will be observed that the backward movements of the head were unrestricted, and the lateral movements only in a slight degree, toward the right side. That this symptom may be entirely absent in extradural tumor of the cervical region, is shown conclusively by a case which I saw in consultation with Dr. David Bovaird in the Presbyterian Hospital, in which an epidural perithelioma was successfully removed by Dr. Joseph Blake.

There was slight tenderness on pressure over the cervical region, but much less than is usual in primary affections of the vertebral column. In this patient a girdle sensation in the epigastric region was observed, as well as transient sensations of constriction about the hips and across the breasts, probably due to irritation of intraspinal tracts.

CASE IV (Summary).—*Extramedullary tumor of the lower cervical and upper dorsal segments. Operation, removal of tumor; death after three days. Onset nine years ago. Without root pains. Gradually increasing paraplegia with sensory disturbances and loss of the sphincter control of the bladder and rectum. Pathological diagnosis—round-celled sarcoma.*

Mrs. R. A., aged forty-six, was admitted to the Presbyterian Hospital June 12, 1905. She was a patient of Dr. I. Abrahamson and was referred by Dr. C. L. Dana, who has seen her in consultation and confirmed the diagnosis. There was a history of a fall, striking on the vertebra prominens. One brother died of a brain tumor, thought to be due to a trauma.

History.—Nine years ago first noticed numbness and weakness in the ulnar distribution of the right hand and forearm, followed by weakness of the hand. These symptoms have pro-

gressed steadily but very slowly. Soon after noticed weakness of the vesical sphincter. Three years ago the right leg first became weak. Two years ago there were, for a time, sharp cutting pains in the right knee varying in intensity, not always present and not increased by use. Soon after this both legs became weak and the knees became stiff, making walking difficult, and finally impossible about nine months ago. For about six months she has had no control of urine, and for the past month no control of flatus. For the past three months, there has been a steady increasing pain in the right submammary region, and recently a girdle sensation, at first on the right and for the past week on both sides. Previous to this she had experienced no root pains.

Examination (June 12, 1905).—The muscles on the ulnar side of right hand and forearm are much weaker than the corresponding muscles on the left. Wasting of the interossei of right hand, less of left, with fibrillary twitchings. Ataxia of the right arm. Wrist and triceps jerks diminished on right, exaggerated on left. Motor power of the lower extremities much diminished, especially on right. Right leg more atrophied than the left. Right thigh and leg flexed, knee contractured, so that patient cannot walk. Knee and ankle clonus exaggerated on the left, but are less on the right (contractures). Babinski on both sides.

Sensation.—Sensibility is diminished along the inner side of the right arm and hand. On the right side from the jaw to the third rib diminished sensibility to touch, below this loss of tactile sensation. On the left side from the jaw to the clavicle there is hyperæsthesia, below this to fourth rib normal, from fourth to fifth ribs diminished sensibility and below this anæsthesia. Right side is anæsthetic to just above the knee, and on the left side to just above ankle. Posteriorly on the right above fourth dorsal spine, diminished sensation, below this anæsthesia; on the left down to the third dorsal spine hyperæsthesia, third to ninth normal, below this anæsthesia. The first dorsal spine is very tender on percussion; the seventh cervical spine is also tender but to a lesser degree.

No control of urine or flatus. Lately there has been pain in the right submammary region and a girdle sensation. The tumor was localized at the eighth cervical and first and second dorsal segments.

Surgical History.—Operation June 14, 1905, under gas and ether anæsthesia. Technic as in previous cases.

Operation.—The fifth, sixth, and seventh cervical and first dorsal spines and laminae were removed and later most of the fourth cervical and second dorsal. Exposed dura tense and without pulsation. On opening it a small amount of clear fluid escaped as if under considerable pressure. This fluid came from a cyst overlying the tumor. The latter was elongated and lobulated and lay on the posterior surface of the cord, flattening it, between the upper margin of the fourth cervical and the lower margin of the second dorsal laminae. The tumor was carefully dissected off the cord by blunt and sharp dissection. Wound closure as in previous cases. During the operation the pulse rose to 120 and there was some cyanosis as the respiration became feeble and irregular, and finally ceased, but it was quickly resumed. An infusion of 1250 c.c. of a 0.09 per cent. salt solution with adrenalin was given on the table. The operation was a long one, lasting over two hours, owing to the length of the tumor and the difficulty of its removal.

Postoperative History.—On recovery from anaesthesia she kept calling for air, but there was no cyanosis or dyspnoea. Two days later, breathing was more labored and on the following day, before death, there was cyanosis. Pain was complained of all over the body, and the patient was restless and at times irrational. The wound was dressed on the third day and a considerable amount of cerebrospinal fluid escaped on removal of the drain. In spite of stimulation the pulse and respiration failed and the patient died seventy hours after operation. During the last twenty-four hours the temperature rose, reaching 105, twelve hours before death, but there was no apparent infection. Microscopic diagnosis of tumor: round-celled sarcoma.

Remarks on Symptomatology.—This case is unusual in that the posterior root pains were absent, although the tumor lay on the posterior aspect of the cord and extended from the sixth cervical to the third dorsal segment. It was only in the later months of the disease, the history of which extended over a period of nine years, that lancinating pains were felt in the right mammary region, evidently corresponding to an irritation produced at the lower pole of the tumor. The clinical picture was ushered in by numbness and weakness of the right

upper extremity, and the early appearance of vesical symptoms. In this case also, as in Case II, fibrillary twitchings were noted in the atrophied muscles of the right hand. The sharp cutting pains in the right knee were probably eccentric in origin from irritation of intraspinal tracts. An abdominal girdle sensation was also present.

CASE V (Summary).—*Extramedullary tumor at the tenth dorsal segment. Successful removal with practically complete restoration of function. No recurrence after four and one-half years. Symptomatology consisted of localized root pain of seven years' duration, which was then followed by gradual compression of the cord, with spastic paraplegia and marked sensory disturbances. Pathological diagnosis: fibrosarcoma.*

History.—Mr. J. S., aged fifty-nine, married, was admitted to the Presbyterian Hospital August 14, 1905. No venereal disease. Trauma to knee and back below the left scapula three months before onset of symptoms. The present trouble began about seven or eight years ago with localized pain in the left side of the back and abdomen, corresponding to the level of the umbilicus. In the earlier years it occurred only at night and in the recumbent posture. It was more or less aching in character with occasional sharp darts. The pain was always unilateral and always limited to the same distribution. It has grown gradually worse during the past few years so that any sudden movement, and even a cough, is sufficient to bring it on. One year ago there appeared a numbness simultaneously in both great toes. This numbness gradually ascended the legs and thighs, eventually reaching the level of the umbilicus. He has also experienced sensations of burning and of cold in the lower extremities. Later there appeared ataxia and weakness of the lower extremities. He has a sensation of constriction in the region of the groins. No pain in the spine.

Examination (August 17, 1905).—Sexual power is diminished and there are slight vesical disturbances. Patient is unable to walk alone. There is a marked Romberg symptom. In the recumbent posture both legs present considerable ataxia. The gross motor power of the lower extremities is diminished, especially on the left side which is spastic, with ankle clonus and Babinski reflex. In the right lower extremity the knee jerk is exag-

gerated, there is pseudoclonus, no Babinski. Cremasteric reflexes are present and the abdominal reflexes at the level of the umbilicus are much exaggerated, especially on the left side. The umbilicus occupied a central position. The spine was not tender and the movements were free.

Sensations.—Below the level of the umbilicus all sensations are disturbed. The anæsthesia is almost complete in the distal portion of the extremities below the knees, very much diminished between the knees and the groin, and very definitely obtunded between the groin and the umbilicus. On the left side, corresponding to the third lumbar spine posteriorly and the umbilicus anteriorly, there is a well marked band of hyperæsthesia.

Surgical History.—Operation August 28, 1905, under gas and ether anæsthesia. Technic the same as in previous cases. The spines and laminae of the eighth, ninth and tenth thoracic vertebrae were removed. The tumor, 2×1.5 cm., was exposed beneath the ninth lamina, surrounded by clear encysted fluid. It was situated posteriorly but somewhat more to the left, and shelled out easily after ligating and dividing a small vascular pedicle at either end. The wound was closed as in previous cases, save for a drain of three strands of catgut through the dura, on account of slight oozing from the veins of the cord.

Postoperative History (September 2).—Has complained of some pain in and above wound and at times he has been restless. Urination and defecation involuntary to-day for the first time. Drain removed; some watery discharge.

September 4: Sutures removed, primary union. Profuse watery discharge noticed on September 5 and on the following day the entire wound was found opened down to the fascia.

On September 7 his neck was retracted and stiff, he was restless and irrational and temperature and pulse had risen again (T. 103.5° on the sixth), after reaching normal. Discharge profuse, becoming more and more purulent, from the exposed granulating surfaces.

On September 9 there was marked tremor and muscular twitching over the entire body, and the patient was apathetic, restless and irrational.

September 14, the discharge has gradually diminished and the temperature fallen.

September 15, lumbar puncture withdrew one ounce of very

faintly turbid fluid which on culture gave non-pathogenic bacilli and cocci, perhaps due to contamination.

September 17, temperature normal. Since lumbar puncture patient has been quiet, more rational and without tremor.

September 19, again irrational. Lumbar puncture, withdrawing four ounces, with similar result. Culture showed saprophytes.

October 2, temperature remittent and when low patient is quiet and nearly rational; when high he is apathetic and has a marked tremor, most marked in the hands. The neck is still somewhat stiff. He has regained control of the rectum and bladder. The wound is nearly healed.

October 22, lumbar puncture, two ounces, fluid normal. Temperature normal and hereafter continued so. Knee jerks normal, no Babinski.

November 9, sat up in chair.

November 13, patient is clear mentally, more cheerful and stronger.

November 16, sensation in lower extremities normal except for muscular sense. Walked about fifty feet. Gait is ataxic. Left leg somewhat weaker than right. Reflexes slightly exaggerated; ankle clonus still present.

November 20, walks with one cane. Discharged improved. The tumor was a fibrosarcoma.

March 10, 1909: Three and one-half years after operation patient can now stand and walk well. No Romberg, no pains, and no paræsthesias. The vesical functions are normal. The left knee jerk is somewhat greater than the right. There is no clonus. The plantar reflexes are normal on both sides. The power of the left leg is somewhat diminished although its general strength is very fair. All qualities of sensations of the lower extremities are well preserved.

Remarks on Symptomatology.—The long history of unilateral root pains, of seven years' duration, limited to the tenth dorsal segment, followed by symptoms of spinal cord compression predominating on the left side, left little doubt as to the diagnosis of tumor and the extramedullary seat of the growth. The abdominal reflexes were greatly exaggerated at the umbilical level, especially on the side of the tumor.

CASE VI (Summary).—*Extramedullary tumor of the sacral region. Operation with successful removal of tumor. Relief of pain but little or no restitution of function. Probable recurrence about a year later. Symptomatology. Pain in the small of the back, left hip and left perianal region for three years, followed by weakness and sensory disturbances in the left lower extremity with loss of the sphincter control of the rectum and bladder. Pathological diagnosis: fibrosarcoma (glioma?).*

History.—Mr. F. N., aged fifty-eight, a manufacturer, was admitted to the Presbyterian Hospital November 13, 1906. He is a patient of Dr. S. A. Lewis, of Springfield, Mass., and was seen by Dr. C. L. Dana in consultation. No history of trauma and no positive venereal history. Present illness began in the summer of 1900 with pains in the small of the back, particularly on stooping and on movements of the spine. For three years pains remained about the same, after which they grew worse so that jarring or any sudden movement was quite painful. Pains are directly in the median line of the back and do not radiate into the sides. A few months later, pains developed in the left hip and gradually extended down the posterolateral aspect of the left thigh. These pains were very sharp and intense but varied considerably in their intensity. Pains were soon followed by numbness of the left thigh and external genitals, and to a less extent on the opposite side. The pain in the small of the back was the sole symptom for three years, and very soon after the pains appeared around the left hip and thigh there followed weakness in the lower extremities and some vesical disturbances. The pain is particularly distressing in the left scrotal and perineal regions and in the left gluteal fold. When a severe paroxysm of pain appears he finds the greatest relief in the upright posture. During these paroxysms the numbness appears over the right thigh. First he had difficulty of micturition and this was followed by incontinence. For the past year he has been unable to control either his urine or his fæces.

Examination (November 13, 1906).—Patient stands on the right leg, the left leg resting gently on the floor, slightly flexed at the knee. There is slight scoliosis. Bending movements of the spine are very fair, with perhaps a little stiffness in the lumbar region. There is no visible atrophy of the muscles of the legs or of the gluteal region. All movements of both lower

extremities are weak, but especially the left. This weakness is especially evident in the movements of the hip. Both knee jerks and both Achilles jerks are absent. The plantar reflexes are present but are diminished on the left. There is no Babinski. The spine is tender from the first to the fifth lumbar, more so over the third, fourth and fifth lumbar spines. There is no one spot of excessive tenderness. Rectal examination is negative. There is no Romberg symptom. He walks fairly well, but the left leg is not moved as freely as the right. The urine dribbles away constantly and is very turbid.

Sensations.—There is a well marked anæsthetic area over both buttocks, extending down the posterior surface of the thighs to about the knees, more marked on the left side. The sensations are also lost over the left hip and are diminished over the outer side of the left thigh, leg and foot. The scrotum, penis and perianal region are anæsthetic on the left side.

Surgical History.—Operation November 15, 1906, under gas and ether anæsthesia. Technic the same as in other cases. The spines and laminæ of the twelfth dorsal and first and second lumbar vertebræ were removed. Pulsation of dura not visible, but palpable. On opening dura, an elongated tumor, not attached to dura, was exposed extending from opposite the spine of the twelfth to nearly opposite that of second lumbar vertebra. Part of the eleventh dorsal and third lumbar laminæ had to be removed to insure complete removal of the tumor. The latter was situated posteriorly and was apparently composed of an upper smaller pinkish and a lower elongated yellowish-white cystic portion. Through the latter part passed two posterior nerve roots, which had to be divided in the removal of the tumor. A couple of small vessels from above required catgut ligature. Wound closed without drainage of dura and with reinforcing silkworm gut sutures.

Postoperative History.—He complained of much pain in the left ankle for the first two or three days. There was also considerable abdominal distress which disappeared only gradually. The urine and fæces were passed involuntarily.

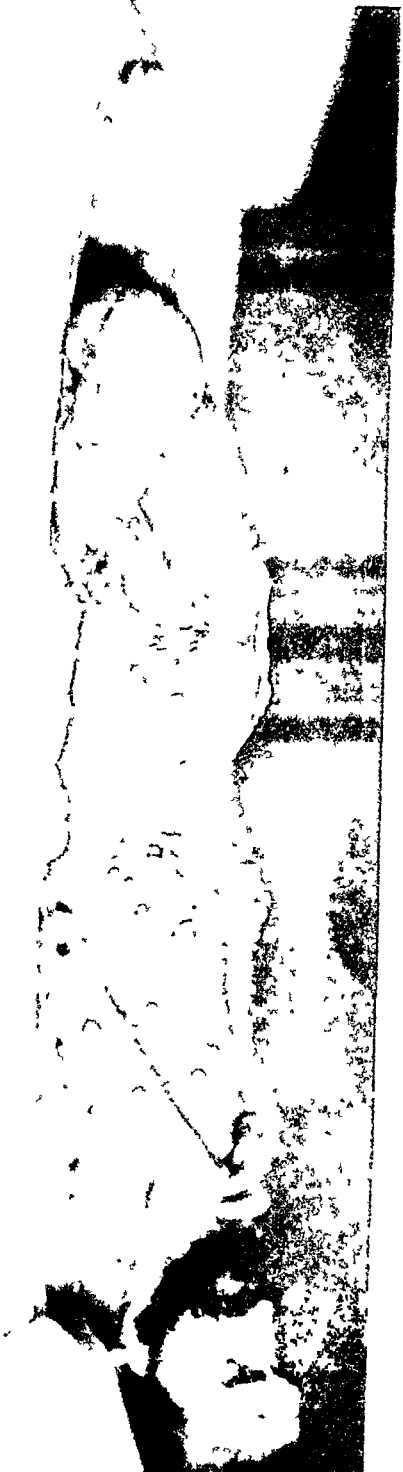
Examination (December 5).—All pains have disappeared except around the anus and perineum, which is similar to that he felt before operation. The left leg is moved in all its segments, but is still considerably weaker than the right. Cremasteric

reflexes not elicitable. Plantar reflex still diminished on the left. The sensations of the entire left leg are practically abolished, including the deep sensibility. Sensation on the right side is normal with the exception of an area corresponding to the right side of the scrotum, penis and perianal region. The right knee jerk is active, the left is still absent. Both Achilles jerks absent.

Allowed to sit up after fourteenth day. December 12, has attempted to get about with walking machine and crutches. He is gaining slowly in control of left leg. There is an area of partial anæsthesia in the sole of the left foot extending up the inner side of the leg, also a saddle-shaped anæsthetic area involving the perineum and buttocks. Wound healed by primary union. Went home December 14, 1906. Pathological examination of tumor, fibrosarcoma (glioma cells probably), but neuroglia stain failed, perhaps due to delay in sending tumor to laboratory. A letter from Dr. S. A. Lewis of Springfield, dated November 9, 1909, says: "The only benefit derived from the operation was the relief from pain, which had been excruciating. There was no improvement in the paralysis or in the control of the sphincters. In the winter of 1907-08 (somewhat over one year after operation) the pains began to recur, with soreness, and it seemed to me the tumor might be recurring. In March, 1908, he was taken one day with severe vomiting, the next day he developed hemiplegia and coma, dying on the second day after. The urine was free from signs of nephritis at this time." There was no autopsy.

Remarks on Symptomatology.—The earliest symptom in this case was localized pain in the lower lumbar region, limited to the median line of the back. It is very probable that this pain was a symptom of meningeal irritation, as during this time there were no referred pains in the region of the perineum, hips, or lower extremities. After the lumbar pain had persisted for about three years, lancinations appeared in the distribution of the lumbosacral nerves on the left side, and were soon followed by paræsthesias, weakness of the extremities and incontinence of the sphincters. The absence of both knee-jerks showed that the pressure effects on the cord extended as high as the third lumbar segment.

Fig. 1



ase VII Extensive neurofibromatosis of the skin (Recklinghausen's disease), in a case with compression paraplegia from a neurofibroma at the fifth cervical segment.

FIG. 2.



Case VII. A solitary extradural neurofibroma at the fifth cervical segment in a case of Recklinghausen's disease. The dura mater has been cut away and the tumor left *in situ*.

CASE VII.—Patient was admitted to Bellevue Hospital on February 1, 1905, in the service of Dr. George Woolsey,¹² and was seen in consultation by Dr. Ramsay Hunt.

Summary.—*Extradural tumor (neurofibroma) at the fifth cervical segment, complicating generalized dermal neurofibromatosis (Recklinghausen's disease); onset with lancinating pains in the shoulder, followed in six months by symptoms of compression of the spinal cord. Because of extreme weakness and emaciation, operation was impossible.*

Family History.—Ten children, six of whom are dead; four died in early life, one brother the result of an accident, and one sister of heart disease. The other three children are living and well; all are married and have healthy children.

The patient was the sixth child and had always enjoyed excellent general health until the onset of the present trouble. He was always somewhat backward mentally, and solitary and peculiar in his disposition. He is of Irish extraction and his parents were not related.

There is no family history of tuberculosis, neuropathic tendencies, or of congenital marks or moles.

The patient is of unusually short stature, and as I have already stated, is backward mentally. He is shy and very easily frightened; has never had friends, and never learned to read or write. He is not alcoholic, but has smoked cigarettes to excess. For the past sixteen years he has worked in a wood-yard, earning \$5.00 a week. He is good natured, and is not subject to outbursts of temper.

The multiple fibromata of the skin, which now cover the surface of his body, first manifested themselves about the fourth year, and have been steadily increasing in size and number ever since. He has never had any pain in them, and his mother is quite certain that they were not present at birth (see Fig. 1).

History of the Present Illness.—Present illness began one year ago, with pains in the left shoulder and left leg. The pain in the shoulder was sharp and lancinating in character, and was soon followed by sensations of pins and needles in the left upper extremity. Six months later, there was weakness of the left arm and soon after the left leg became similarly affected. These symptoms of weakness on the left side increased gradually, and were followed in the course of two months by weakness of the

right leg, when vesical symptoms also made their appearance. There has been a steady progression of the paralysis, with loss of sensation, complete incontinence of the sphincters, and the development of extensive bed-sores.

Examination (February 1, 1905).—Patient is of small stature, and very fragile skeletal development, except the head which is large and square. There is an extraordinary development of neurofibromatosis nodules of the skin, covering the face, trunk, back, and arms. They vary in size from a pin to a cherry. The pupils and cranial nerves are normal. Movements of the neck are free. No deformity or tenderness of the spine. The motor power of the left arm is almost abolished; external and internal rotation of the shoulder are, however, still present, but are very weak. Abduction and adduction are barely indicated by muscular contractions. There is also slight flexion of the elbow, which includes the supinator longus, but the paralysis of the extensors of the elbow and of the muscles of the wrist and fingers is complete.

In the right arm, movements of the shoulder, as well as flexion of the elbow, are preserved but weak; but there is a complete paralysis of the extensors of the elbow and of the muscles of the wrist and fingers.

The musculature of both hands and forearms is atrophic, but no fibrillary twitchings are observed. Breathing is purely diaphragmatic.

The left leg is paralyzed, with the exception of slight flexion of the left knee. The right leg is also paralyzed, save for flexion movements of the leg and weak flexion and extension of the foot.

Both legs are fixed in a flexed position and the knee-jerks are not elicitable (possibly because of the extreme flexion contracture). The left Achilles-jerk is present, but there is no clonus. On the right side, ankle clonus is present. Babinski's reflex is present on both sides. Abdominal reflexes are absent.

Shockingly large deep bed-sores are present over both hips and the sacrum, exposing the bony structure in all three localities, and discharging freely.

Careful examination of the peripheral nerves accessible to palpation fail to reveal any nodulations or varicosities, although the nerve-trunks themselves seem hard and thickened.

Sensations were somewhat difficult to test, because of the

mental state of the patient and his deplorable condition. There was, however, complete absence of pain, temperature, and tactile sensation as high as the third rib, anteriorly. There were also paræsthesias in the upper extremities, and the tactile sense was blunted, but the exact area on the arms could not be demarcated.

Note.—While the diagnosis, neurofibroma in the cervical region compressing the spinal cord, seemed reasonable, the condition of the patient precluded any attempt at operation.

In spite of careful nursing and care, the patient died on March 4, 1905. Permission was obtained to remove only the spinal cord and a few of the skin tumors, so that the condition of the brain and cranial nerves and the peripheral nerve-trunks could not be ascertained. A few of the posterior ganglia were removed with the spinal cord, but these were not enlarged.

At the level of the fifth cervical segment, a small rounded tumor the size of a hazel-nut was found outside the dura, at the junction of the anterior and posterior roots. It was pearly white in color and was encapsulated. On removing the dura, it was found that the tumor fitted into a depression on the anterolateral surface of the cord. Passing into the tumor was the anterior root of the fifth cervical nerve, the posterior roots passing over the surface of the tumor and being lost in its capsule. All the other nerve-roots were normal to the naked eye and presented no swellings or varicosities (see Fig. 2).

Histological Examination.—The spinal cord examined at various levels showed the typical secondary degenerations, above and below the level of the lesion,—more marked upon the left side. There were no evidences of neurofibromatosis in the nerve-roots or in the strands of the cauda equina.

Remarks.—This case is recorded because of the comparative rarity of the pathological lesions, and as an illustration of the diagnostic importance of cutaneous fibromata when associated with symptoms referable to the spinal cord. The tumor was correctly localized, and could have been removed with ease by an operative procedure had the general condition of the patient justified it. The small stature and low grade of mental development which were present have occasionally been noted in Recklinghausen's disease.

Histological examination of the spinal cord, including its roots, the cauda equina, and several spinal ganglia, fail to reveal any evidences of neurofibromatosis, with the exception of the tumor which had compressed the fifth cervical segment. So far, therefore, as the spinal axis is concerned, it was a solitary manifestation of the neurofibromatosis. Unfortunately, the brain and peripheral nerves were not available for examination. A solitary neurofibroma of the spinal axis as a complication of a generalized dermal neurofibromatosis may occur, but usually the tumors are multiple and are associated with varicose thickenings and nodosities of the nerve-roots. A case of this description I have already reported in detail,¹³—one in which an intravertebral neurofibroma in the cervical region had produced a complete destruction of the cord. In addition to this single large growth, all of the anterior and posterior roots in the cervical region were the seats of nodular tumor formation, and many of the spinal ganglia were similarly involved. There was also extensive neurofibromatosis of the peripheral nerve-trunks, and a large plexiform neuroma was situated in the subcutaneous tissues of the lower abdominal region.

CASE VIII (Summary).—*Intramedullary tumor of the upper cervical region, fourteen years' duration. Onset with pain, lasting three years, followed by progressive spastic paralysis of the left arm and leg, and a contralateral anæsthesia (Brown-Séquard paralysis); slow progression of symptoms, with gradually increasing weakness of the left side, and ataxia and anæsthesia of the right.*

Exploratory Operation.—*Third, fourth, and fifth cervical laminæ removed. Cord normal but somewhat swollen. Evacuation of two drachms of cystic fluid from the interior of the cord on its posterior aspect.*

[Referred to Dr. Ramsay Hunt by Dr. H. S. Paterson, of New York.] Woman, aged thirty-six, nurse-maid by occupation. No history of injury.

History (October 17, 1907).—Her present illness dates back twelve years and began with shooting pains in the posterior

aspect of the left shoulder. In the course of a few months, similar pains appeared in the corresponding region of the right side, but they were never quite so severe as on the left side. These pains lasted in all about three years, with occasional intermissions and varying considerably in their intensity. They gradually subsided and finally disappeared; during this time she was treated for rheumatism.

Soon after the pain in the shoulders appeared, she had pains in the knees on both sides, lasting for several months, which were of the same sharp and shooting character.

Nine years ago, *i.e.*, about three years after the onset of the shoulder pains, the left arm became weak, and a little later the left leg was similarly affected. The paresis of the left arm and leg has gradually increased, more especially during the past year, and is accompanied by increasing stiffness of the muscles.

For some years she has noticed that there is absence of perspiration on the left side of the body.

One year ago, numbness and prickling sensations were first noted in the right foot; these have gradually ascended the leg to the hip. In bathing, she has noticed that the right leg was less sensitive to heat than the left. A few weeks ago, the fingers of the right hand became numb. There have been no vesical symptoms at any time.

She has always been constipated, but more of late; there is no girdle sensation. She has no pain in the spine, and the left side of the body is quite free from paræsthesias.

Examination (October 17, 1907).—Station normal, but the gait is typically hemiplegic. There is a well-marked spastic paralysis of the left arm and leg, with exaggeration of the tendon reflexes and ankle clonus.

The tendon reflexes are also exaggerated on the right side, on which ankle clonus is also present. Babinski is present on both sides. The abdominal reflexes are absent. There is a slight atrophy of the muscles of the left shoulder, and distinct fibrillary twitchings are present in the left trapezius muscle, as well as in the second and third intercostal spaces on the left side.

The spine is mobile and absolutely free from any tenderness or rigidity. There is a distinct kyphoscoliosis in the cervical and upper dorsal regions, the convexity directed toward the left. The percussion note over the cervical region shows no dulness. The neck muscles on the left side are somewhat spastic.

Sensations.—The superficial sensations on the left side of the body are entirely normal, with the exception of the neck, where a zone of dissociated anæsthesia is intercalated between the lower margin of the jaw and the clavicle, anteriorly, and the lower occipital region and the spine of the scapula, posteriorly.

On the entire right side of the body there is a marked disturbance of sensation below the ramus of the jaw, anteriorly, and the occiput, posteriorly, involving the pain and temperature sensibility; tactile sensibility is also disturbed on the right side, but in a lesser degree, and chiefly over the distal portions of the extremities, *i.e.*, below the wrist and knee.

The deep sensibility of the hands is normal; there is no ataxia of the arms and the articular sense of the toes is undisturbed on both sides. Sensation of the face is normal.

Pupils are equal and react normally; no oculopupillary symptoms.

The probable diagnosis of a central gliosis of the spinal cord was made; as the patient was able to pursue her occupation as nurse-maid, and suffered no pain, an exploratory laminectomy was not urged. She was therefore placed alternately upon iodides and arsenic.

December 20, 1907: Patient has had no pain since last examination. No vesical symptoms.

For the past two weeks, she has felt a unilateral girdle sensation on the right side at the umbilical level, which increases in the recumbent posture.

The objective examination is unchanged, except that the left hand and arm are somewhat weaker, and the numbness of the right hand is more constant and annoying.

May 29, 1908: Patient is still free from pain; girdle sensation has disappeared. There is constant and increasing paræsthesia of the right hand. She has continued her occupation as nurse-maid and is still able to sew and work with the right hand. The objective examination practically unchanged.

March 17, 1909: For some weeks, patient has again experienced the unilateral girdle sensation on the right side at the level of the umbilicus, which was previously noted. No pain and no vesical symptoms. The cranial nerves are negative, and the objective examination remains unchanged. It was noted that the erector pili reflex is absent on the left side.

October 24, 1909: For the past two months the right hand has been stiff and awkward. The functions of the right leg, except for increasing paræsthesias and sensory loss, are unimpaired. She has experienced occasional sharp twinges of pain in the upper right intercostal region, but neither constant nor severe.

February 6, 1910: The right arm and leg are both worse. It is impossible to use the right hand now for sewing and finer work, and she was forced to abandon her occupation two months ago.

There is astereognosis of the right hand and the deep sensibility of the toes on the left side is abolished, but is present on the right. Numbness of the left leg is now present, which has ascended to the knee.

Examination.—Station shows slight Romberg. Spinal hemiplegia of the left side has increased. The cranial nerves are all normal; the optic discs are negative. Percussion of the cervical spine reveals no tenderness and no change in the percussion note. Fibrillary twitchings are present in the trapezius and supra- and infraspinal muscles on both sides. No oculopupillary symptoms are present. The erector pili reflex is absent on the left side of the trunk, and occasional jumping and starting spasms occur in the extremities at night. No vesical symptoms.

Sensation.—The superficial sensations are very much as noted in previous examinations. There is anæsthesia from the level of the jaw, anteriorly, and from the lower occipital region, posteriorly, throughout the entire right side, which is complete over the distal portions of the extremities and the right side of the trunk and neck; it is less marked along the inner side of the arms and thighs.

The sensations of the left side of the body are normal, except for a strip of anæsthesia between the jaw and clavicle, anteriorly, and occiput and spine of the scapula, posteriorly, where the loss of pain and temperature sense is complete, and the tactile sensation is diminished but not lost.

There is marked astereognosis of the right hand. The deep sensibility of the toes on the left side is lost, but is preserved on the right.

There is a slight hyperæsthetic zone along the lower jaw on both sides and across the upper thoracic region (second and third ribs).

An exploratory operation was performed at my request, on March 28, 1910, by Dr. Woolsey. The third, fourth, and fifth laminae were removed; the dura mater was swollen and there was no pulsation. After incision of the dura, there was a copious discharge of cerebrospinal fluid—about four ounces. In the middle of the bone wound and a little to the right of the median line, a dark and somewhat discolored spot appeared on the posterior aspect of the cord; its surface was smooth and covered by pia mater. The cord was swollen, but no other abnormalities could be detected. A puncture was made over the discolored area near the median line, and about two drachms of clear fluid escaped, and as it flowed out, the posterior aspect of the cord collapsed. The walls of the cavity, from which the fluid escaped, seen through the small puncture which was made, appeared of a brownish hue. The anterior and lateral regions of the cord and the nerve-roots were normal to the naked eye.

Examination (April 8, 1910).—Has made a good recovery from the operation. Had considerable pain in the shoulder for the first few days, and there was some weakness of the right arm, with increased weakness of the left arm and leg, which has rapidly improved. She has good control of the sphincters; there are no oculopupillary symptoms. Sensory symptoms unchanged.

Remarks.—The diagnosis of a tumor growth seemed clear from the occurrence of root pains in a circumscribed distribution, followed by symptoms of unilateral compression of the cord, gradually progressing. It was, however, by no means easy to determine whether the growth was extra- or intra-medullary in origin. In favor of a tumor without the cord and compressing it were the initial pains covering a period of three years, a Brown-Séquard paralysis of very gradual development, and the extremely long and progressive course of the disease (about fourteen years). Central tumors (slowly growing glioma and gliosis) may, however, present a very similar picture, and this was regarded as the probable diagnosis. There were, however, no trophic disturbances, and the anæsthesia was not of the dissociated type, save the strip on the left side of the neck between the jaw and the clavicle. The fibrillary twitchings which were present may also occur in

extramedullary tumors, so that great weight could not be attached to their presence, and, in a hemiplegia of such long standing as had existed in the case, a kyphoscoliosis, so common in syringomyelia and spinal gliosis, would not have much diagnostic significance. As the condition of the patient grew worse and the right hand became seriously involved, she decided to submit to an exploratory operation. It is, as yet, too soon to say how great a benefit will be derived from the evacuation of the cystic fluid within the cord. The recovery from the operative procedure was rapid, and the initial operative paresis soon wore off. It is interesting to note that the girdle sensation disappeared after the operation.

CASE IX (Summary).—Central intramedullary tumor of the cervical region, exploratory laminectomy performed; growth inoperable, and the wound closed. Recovery from the operation; patient died some months later with complete motor and sensory paralysis. Onset of symptoms with weakness and numbness of the left hand, three months later appearing in the right. Gradual progression of symptoms; weakness and atrophies of the upper extremities, anæsthesia, and spastic paraplegia. Occasional pains and symptoms of posterior root irritation in the distribution of the cervical nerves.

History.—The patient, a married woman aged thirty-seven, was referred to Dr. Ramsay Hunt by Dr. William M. Polk. She had borne seven children, all healthy. She had had two miscarriages, and the husband gave a positive history of syphilis acquired five years before marriage. There was no history of injury. Onset of symptoms, in November, 1908, with numbness on the ulnar side of the left hand, which was soon followed by weakness of the fingers. Three months later, a numb feeling developed in the middle finger of the right hand, which gradually extended over the entire palmar surface of the hand. She had occasional shifting pains in the arms and legs, but these were not constant and not severe. She also had occasionally pains in the back of the neck. The weakness of the hands gradually increased, and the numbness extended over the palms and fingers. There are no vesical symptoms. At times she experiences a feeling of numbness over the abdomen and on the left thigh; and the left leg, subjectively, is weak.

Examination (February 27, 1909).—The gait and station are normal. Pupils are equal and react normally. There is a distinct weakness of the intrinsic muscles of both hands, which is more marked on the left. Extension of the wrists is also weak. There is a moderate degree of atrophy of the intrinsic muscles of the left hand, which is also present to a lesser extent on the right. The supinator and biceps reflexes are present; the triceps jerks are absent; the knee-jerks and ankle-jerks are active on both sides. There is no ankle clonus, and no Babinski reflex on either side.

Sensations are normal, with the exception of a strip of anæsthesia along the ulnar side of the hands and forearms on both sides, more marked upon the left. The tactile, pain, and temperature sensations are all equally involved (there is no dissociation of sensibility). The spinal column is perfectly mobile, and there are no areas of tenderness.

April 28, 1909: The patient's condition is distinctly worse in spite of a thorough course of iodides and mercury. The hands are weaker, and she complains of the legs and trunk feeling numb and cold. There are also slight twitching and trembling movements in the fingers (coarse fibrillations); no oculopupillary symptoms. The sensations are about the same as at the last examination, except that the strip of anæsthesia which was present on the ulnar side of hands and forearms has ascended along the inner side of the left upper arm.

June 1, 1909: For the past ten days had had vesical trouble for the first time, which followed a very severe paroxysm of pain in the neck and arms, lasting several weeks. Coinciding with this paroxysm of pain, the left pupil became temporarily smaller than the right, and there was a slight drooping of the left eyelid. The left leg was also the seat of transient weakness.

June 22, 1909: Movements of the neck are free, and there is no pain except occasional painful paræsthesias in the left hand. The eyes are normal, and there are no vesical symptoms. At times the left hand swells and becomes red and tender. The left leg, subjectively, is weak and numb. The hands are weaker, and the anæsthesia has extended to the trunk upon the left side, reaching from the third intercostal space on the left side to the level of the umbilicus; all sensations are involved. The strip of anæsthesia on the arms, which at the last examination was con-

fined to the inner side of both upper extremities, has now passed around and includes the posterior aspect as well. Her condition has grown steadily worse, notwithstanding a hypodermic course of mercury and large doses of the iodides. The question of exploratory laminectomy was discussed, but it was decided to wait until the autumn, unless her symptoms took a sudden turn for the worse.

September 17, 1909: During July and August she had a few attacks of pain, centred in the midspinal region at the level of the sixth and seventh cervical vertebræ. These paroxysms of pain, however, were not so severe as the one noted in June. For the past few weeks she has had difficulty in controlling the sphincters, and the legs are growing weaker. The weakness is greater on the left side, and although she stands and walks well there is a tendency to drag the left leg. The right pupil is larger than the left, but there is no ptosis and no enophthalmos. The cranial nerves are normal. Ankle clonus is present on both sides, more marked on the left, and Babinski reflex on both sides. The spinal column is negative. There is complete anæsthesia to touch, pain, and temperature below the level of the third rib anteriorly, which includes the inner and posterior aspect of both upper extremities. The articular sense of the toes is also disturbed on both sides. The hands are weaker, their intrinsic muscles are more atrophied, and fibrillary twitchings are present.

October 6, 1909: For the past three weeks has had considerable pain in the back of neck, extending up to the occiput. Percussion of the spine is negative, and there is no tenderness or rigidity. Weakness of the sphincters of the bladder and rectum. There is extreme weakness of the movements of the wrists and fingers and extension of the elbows, more marked upon the left side. The flexion of the elbows and movements of the shoulders are well preserved. The oculopupillary symptom (ptosis, myosis, and enophthalmos) typically present on the left side. There is spastic paraparesis of the lower extremities, with clonus, more marked on the left. Superficial sensations are practically abolished below the level of the third rib anteriorly. The abdominal reflexes are absent.

An exploratory operation was performed October 11, 1909, at my request, by Dr. Frank Hartley at the New York Hospital. The spines and laminæ of the sixth and seventh cervical vertebræ

were removed. The dura does not pulsate and appears distended. After it was incised, there was a gush of cerebrospinal fluid under considerable pressure. The pia mater is smooth and glistening, but the cord itself is swollen, and is of a pinkish and mottled hue. It evidently contains an intramedullary tumor; extirpation was impossible. Exploratory puncture of the cord was not deemed advisable, and the wound was closed.

The patient recovered from the effects of the operation, but her condition grew steadily worse and she died four months later, having developed a total transverse lesion of the spinal cord, with contractures and bed-sores. No autopsy was performed.

Remarks.—The symptoms and clinical course of this case were in favor of a central, intramedullary tumor of the cord. She had experienced, however, from time to time, severe pains in the neck in the distribution of the cervical nerves, and as all other forms of treatment had been of no avail, and her condition was gradually progressing, it was deemed wise to give her the benefit of the doubt and explore the spinal cord at the diseased level. I would emphasize the fact that at no time did she present a definite dissociated anæsthesia (loss of pain and temperature sense), which is so common in central tumors. This, in conjunction with the symptoms of posterior root irritation, were regarded as sufficient to justify the exploration.

CASE X (Summary).—Spindle-cell sarcoma of the meninges at the level of the second, third, and fourth dorsal segments. Exploratory laminectomy, but extirpation of the tumor was impracticable, and the wound was closed. Onset of symptoms December, 1901, with lancinating pains between and beneath the shoulder-blades, also encircling the chest in the upper intercostal spaces. Six months later, bilateral symptoms of spinal cord compression, which rapidly progressed to complete motor and sensory paralysis. Rigidity of cervical and upper dorsal regions, with localized tenderness.

Patient, a man aged twenty-three, was admitted to Bellevue Hospital in the service of Dr. Dana, through whose courtesy I was enabled to observe the case. He denies syphilis, and gives no history of injury. In the latter part of December, 1901,

he was seized with pain in the upper portion of the back between the shoulder-blades, which was especially severe and constant over the lower angle of the right scapula. At first the pain occurred only at night, and during the day he was practically free from it. Later the lancination became more severe, and radiated into the upper intercostal spaces on both sides; at times there were sharp pains in the depths of the axilla, which would shoot into the arm. In July, 1902, the lower extremities became weak and numb, and there was retention of urine. At this time there were frequent spasmodic twitchings of the lower extremities, and the legs would be drawn up under him by spontaneous contractions. By the latter part of July, the lower extremities were so weak that he was forced to take to his bed, and a complete paraplegia with incontinence of urine and sensory disturbances supervened.

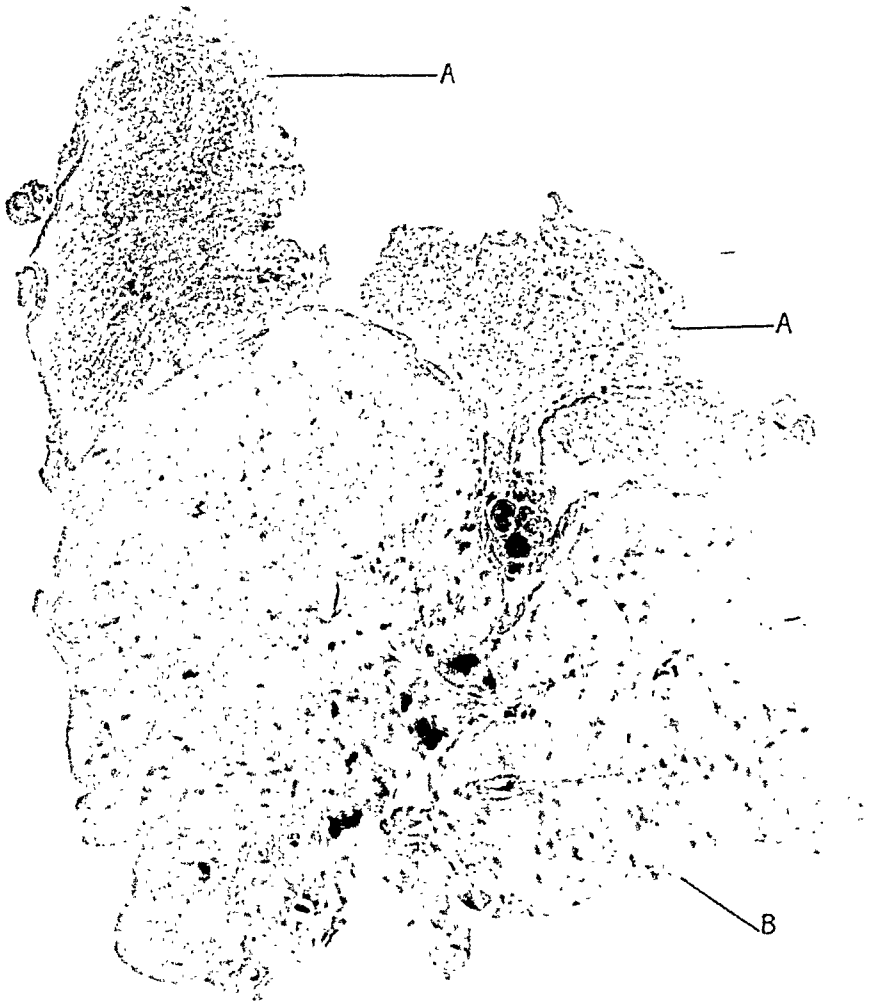
Examination (October, 1902).—The cranial nerves and pupillary reflexes are normal. Gross motor power, the sensation, and reflexes of the upper extremities are normal. The head is held in a position of fixation; lateral movements may be carried out, but are somewhat restricted. There is considerable restriction of the forward and backward movements of the head. Palpation of the pharynx is negative. In the upper dorsal region, corresponding to the sixth, seventh, and eighth dorsal spines, there is a slight prominence, and a distinct area of tenderness to the left of the sixth dorsal spine. Jarring of the vertebral column does not produce pain. There is complete paraplegia, with incontinence of urine, ankle clonus, Babinski, and exaggeration of the tendon reflexes. The abdominal and cremasteric reflexes are absent. There is also complete anæsthesia, reaching as high as the nipple line anteriorly, and the fifth dorsal spine posteriorly. Immediately above the line of anæsthesia is situated an hyperæsthetic band about three inches in width. The temperature is generally normal, but there are occasional rises to 100° and 101° F. The lungs are normal. On November 18, an injection of tuberculin was made, with negative result. On December 1, another injection of tuberculin was followed by a rise of temperature to 103.6° F., the highest point which the temperature had yet attained. Antisyphilitic remedies had been tried without avail, and as fixation and extension of the spine had produced no amelioration of symptoms, an exploratory operation was decided upon.

Operation (December 17, 1902).—Operation by Dr. Gallaudet. Ether anæsthesia. An incision was made in the median line over the upper dorsal region. The spines and laminae of the fourth, third, second, and first dorsal vertebrae were removed in turn. No abnormality of bone or dura was detected. The dura was somewhat swollen and did not pulsate. On incising it, at the level of the second dorsal spine, the spinal cord bulged through the opening and was found to be enlarged, softened, and of a whitish color. The tumor could not be demarcated from the surrounding cord substance, so that any attempt at extirpation was found to be impossible and the wound was closed. The patient recovered from the immediate effects of the operation, but died January 3, 1903.

No autopsy was performed, but the wound was opened, and a section of the spinal cord between the seventh cervical and fifth dorsal spines was removed. At its middle portion, which corresponded to the second and third dorsal segments, there is a large tumor mass two inches in length and three-quarters of an inch in width, which is irregularly nodular externally and presents a white homogeneous appearance on the surface of section. The growth is intimately attached to the inner surface of the dura and the pia mater, and has caused almost complete destruction of the cord (see Fig. 3). Histologically, the growth is a spindle-cell sarcoma, apparently taking its origin from the inner surface of the dura, although sarcomatous infiltration is also present on the external surface of the pia arachnoid (see Fig. 4). The cord substance itself is compressed but not infiltrated (compression myelitis).

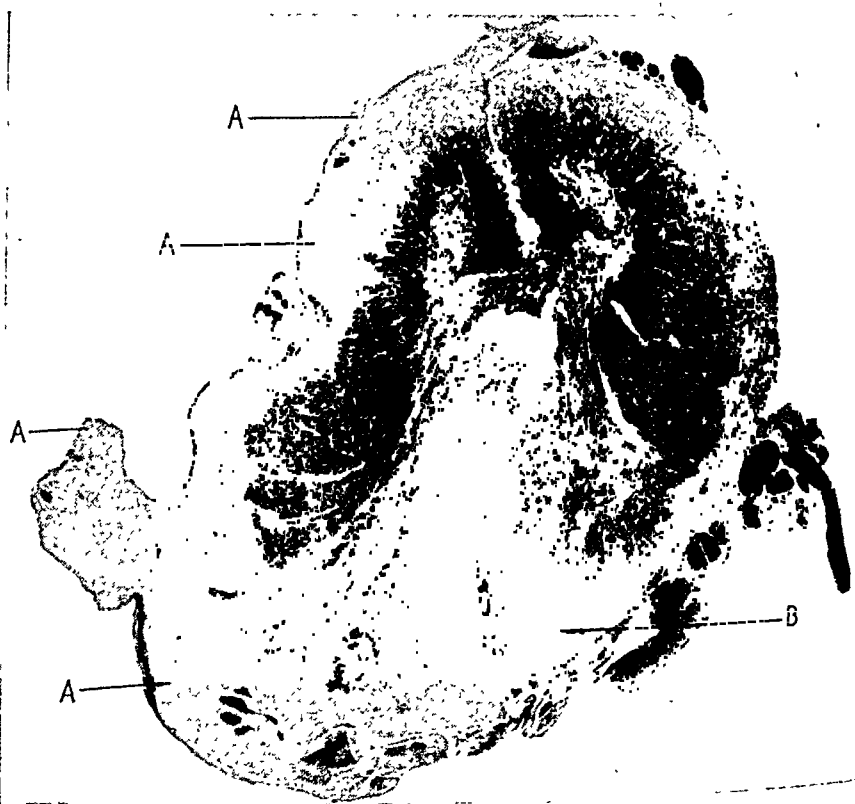
Remarks on Symptomatology.—The onset of the clinical picture, with lancinating pain, bilateral and segmental in distribution, followed in six months by symptoms of rapidly developing medullary compression, were in favor of a rapidly growing neoplasm. There was, however, some uncertainty regarding the nature of the affection. For a time, tubercular caries, with compression, was considered, and this view was confirmed by what seemed to be a positive tuberculin reaction. The rigidity, with slight vertebral deformity at the level of the sixth, seventh, and eighth dorsal spines, with tenderness

FIG. 3.



Case X. Spindle-cell sarcoma of the meninges, compressing the cord at the third and fourth dorsal segments (Weigert-Pal method). A, remains of spinal cord; B, tumor.

FIG. 4.



Case X. *A*, spindle-cell sarcoma of the pia mater surrounding and compressing the anterior and posterior nerve roots; *B*, ascending degenerations in the posterior columns. (Weigert-Pal method.)

and occasional rises of temperature, were also in favor of this view. There was, however, no pain on jarring the vertebral column. A syphilitic affection was also considered, especially the pachymeningitis syphilitica, but no amelioration of symptoms followed the use of iodides and mercury, so that, as a last resort, an exploratory laminectomy seemed advisable.

CASE XI (Summary).—Onset with shooting pains in the hips, lower lumbar region, and front of the thighs. Four months later, weakness of the lower extremities, with paræsthesia and sensory disturbances. Rapid progression of symptoms, followed by complete paralysis of motion and sensation below the level of the twelfth dorsal segments. Extreme atrophy of the muscles in the gluteal region on both sides. Autopsy revealed a spindle-cell sarcoma of the meninges, with complete destruction of the cord in the lumbar region.

History.—The patient, a woman twenty-three years of age, was seen in consultation by Dr. Ramsay Hunt with Dr. R. L. MacFarland at the Jamaica Hospital, L. I. There was no history of syphilis or injury. Onset of symptoms in April, 1902, with shooting pains in the region of the right hip. A few weeks later, similar pains, of lancinating character, were felt in the corresponding region of the left side. She also had pain in the lower lumbar region, and, later, shooting pains down the anterior and lateral aspect of the thighs. These pains continued during the early summer and were very severe. The last of July, weakness and paræsthesias of the lower extremities made their appearance. In August, the right leg was completely paralyzed, and the left partially so, with marked sensory disturbances. There was also retention of urine followed by incontinence. In November, the paralysis was complete. During this time lancinating pains had continued, but with less intensity.

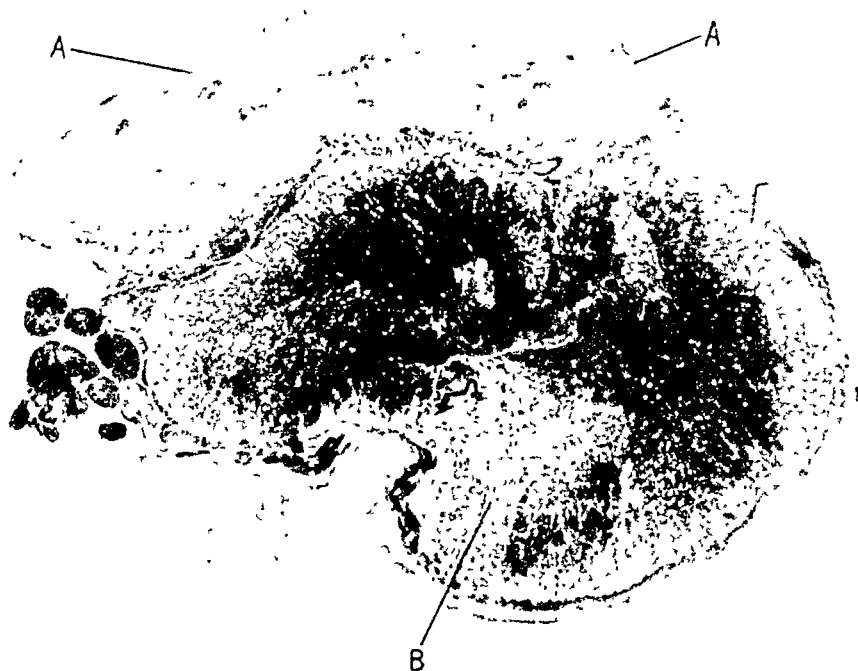
Examination (February 28, 1903).—The patient is well built and somewhat emaciated. Above the waist-line the physical examination is negative. There is a slight lateral curvature of the spine in the dorsolumbar region, but no kyphosis or abnormal projection of the spinous processes. The tenth and eleventh dorsal spines are very tender on direct pressure, but jarring produces no pain in the vertebral column at this level. In the sitting posture, there are pain and a girdle sensation which encircles the

body at the umbilical level. Posteriorly, there is practically complete atrophy of the gluteal muscles on both sides, so that all the anatomical landmarks of the pelvis stand out clearly on its posterior aspect. No fibrillations. The thighs and legs present a slight degree of general wasting, but no definite localized atrophy, as in the buttocks. There is a complete flaccid paraplegia, with loss of tendon and plantar reflexes. There is also complete loss of all sensation below a line midway between the navel and pubes anteriorly and the fifth lumbar spine posteriorly. The feet and ankles are somewhat œdematous. There is a bed-sore over the sacrum, and others over the left buttock and the left heel.

The diagnosis was made of a rapidly growing tumor compressing the spinal cord in the lumbar region. The case was regarded as unfavorable for operation. A few months later the woman died, and the *autopsy* revealed a sarcoma of the meninges in the lumbar region. The vertebræ were free from disease. Through the kindness of Dr. MacFarland, the lower portion of the spinal cord was sent to me for examination. The tumor mass is a spindle-cell sarcoma, three inches long, and lay on the right anterolateral aspect of the lumbar cord. It apparently takes its origin from the inner surface of the dura mater. There is no evidence of growth on the external surface of the dura. The cord was not infiltrated by the growth, but was completely disorganized by the compression to which it was subjected. The tumor growth infiltrates the pia arachnoid on the anterior aspect of the cord in the lumbar region, surrounding and destroying the anterior roots (see Fig. 5).

Remarks.—This case is very similar in its course and symptomatology to Case X. Onset with lancinating pains in the distribution of the first, second, and third lumbar segments, which were followed in about three months by the symptoms of medullary compression, which progressed rapidly to complete motor and sensory paralysis below the level of the twelfth dorsal segment. Practically, the symptoms were bilateral in distribution, although the initial pain was felt first on the right side, and the right leg was the first to become weak. The extensive early wasting of the muscles of the buttocks

FIG. 5.



Case XI Spindle-cell sarcoma of the meninges, showing infiltration of pia mater on the anterior surface of the cord, surrounding the anterior roots. *A*, tumor growth, *B*, degenerations in posterior columns. (Weigert-Pal method.)

is probably due to invasion of the anterior root of the lower lumbar and upper sacral segments. I consider the short duration of the root pains, their bilateral distribution, and the early appearance of symptoms indicating medullary compression as distinctly unfavorable signs as regards the operability of the tumor—these symptoms suggesting a rapidly growing malignant neoplasm of inoperable character.

CASE XII (Summary).—*Onset with pains in lumbar region followed by lancinations in the distribution of the first lumbar segment on both sides. Ten months later, gradual development of a compression paraplegia. Vertebral column practically negative, save for an insignificant prominence of the tenth dorsal spine. Exploratory laminectomy revealed an infiltrating tumor of the spines and laminae of the eleventh and twelfth dorsal vertebrae, compressing the nerve roots in the intravertebral foramina as well as the cord within the spinal canal. Pathological diagnosis—carcinoma (a small scirrhous growth was later discovered in the left breast which had remained latent).*

History.—The patient, a woman aged forty-seven, was referred to Dr. Ramsay Hunt by Dr. Frank Meara on December 26, 1908. She had borne two healthy children, and had had two miscarriages; no history of injury. She is well nourished, has a good color, but is very nervous as the result of her long suffering. Her illness began in December, 1907, with pain in the lumbosacral region, regarded at first as probably rheumatic, but which did not respond to treatment. These pains in the lumbosacral region continued with variable intensity until May, when there was an interval of about six weeks in which she was entirely free. The pains in the lower lumbar region then reappeared, and were accompanied by shooting pains around the hips on both sides. When severe, the pains extended up the spine between the shoulders. The pains continued during the entire summer, increasing in severity, and in November, 1908, was first noticed an unusual coldness of the feet below the ankle (sensation of freezing). This was soon followed by paræsthesias of the feet and ankles and, later, weakness, more especially of the left leg. When the lumbosacral pains were especially severe, the back became quite stiff in this region. No shooting or lancinating pains were felt except around the hips, and these were equal in intensity on the two sides. No vesical symptoms.

Examination (December 27, 1910).—Patient is bed ridden and cannot stand or walk without assistance. The spine is normal in mobility and in appearance (no deformity). There is absolutely no pain on jarring; there is, however, some tenderness on pressure over the second and third lumbar spines (which was slight and was not confirmed on subsequent examinations).

There is a spastic weakness of the lower extremities, more marked of the left leg, on which side ankle clonus is present; Babinski reflex present on both sides; abdominal reflexes present and active. There is a band of hyperæsthesia and hyperalgesia in the lower lumbar region, which encircles the body at the level of the groins.

Sensations.—The temperature sense of the lower extremities is disturbed. Tactile, pain, and deep sensibility are normal. There are areas of analgesia over the right hip in the distribution of the first lumbar nerve.

January 16, 1910: Patient was again examined in consultation with Dr. Dana. She still has pain in the lower lumbar region, especially at night, but less severe than formerly. Lancinating pains are still felt around the hips, of equal intensity on the two sides. No vesical symptoms. Weakness of the legs has progressed, in spite of the administration of iodides.

The spine is absolutely normal in appearance and mobility, and there is no tenderness demonstrable on pressure.

Sensations.—There is distinct loss of pain and temperature sensibility over the lower extremities, with preservation of the tactile sense. In the distribution of the first lumbar segment on both sides, distinct areas of anæsthesia to pain and touch are present.

February 26, 1910: Her condition is worse, paralysis has increased, and sensation shows greater impairment. There is now some disturbance of the vesical function. In the sitting posture there is noticeable for the first time a very slight prominence of the tenth dorsal spine. It is not marked, and there is no tenderness on pressure. Jarring of the spine produces moderate pain, which radiates in the region of the hips. There is an "erector-spinae reflex" in the lumbar region, stroking or pricking of the skin invoking a muscular contraction.

March 5, 1910: Paralysis of motion and sensation continues to increase. Marked vesical disturbance. There is still pain in

the lumbar region and the hips. Sensation of pain and temperature especially, but also tactile sensibility is disturbed as high as the distribution of the first lumbar segment. The spinal column is perfectly normal in its mobility, and there is not the slightest trace of rigidity or of tenderness. *There is no pain on jarring.* The tenth dorsal spine is still slightly prominent, but this has not increased. There has been no elevation of temperature during her illness. The lungs are normal, and the other internal organs are negative. It was decided to perform an exploratory operation.

March 10, 1910: Exploratory laminectomy was performed by Dr. Frank Hartley at the New York Hospital. The spines and laminae of the tenth, eleventh, and twelfth dorsal vertebrae were removed. On cutting away the spines from the eleventh and twelfth dorsal, they were found to be softened and infiltrated with tumor growth, which could be traced into the lumbar muscles of the left side. The roots of the twelfth dorsal and the first lumbar segments passed out through the growth on both sides. A collection of tumor tissue was also found within the spinal canal on the left side at the level of the twelfth dorsal and first and second lumbar segments, which had compressed and deformed the cord. The dura mater was normal in appearance and was not incised.

Immediately after the operation, patient went into collapse but revived after stimulation and the subcutaneous infusion of a salt solution. Histological diagnosis of tumor—carcinoma.

Note.—Following the pathological report, a careful palpation of the breasts was made, which revealed a small fibrous nodule on the left side. This had never been the seat of pain, and its presence was unknown to the patient. It was apparently a latent carcinoma of the breast which had caused no local symptoms. The patient made a good recovery from the operation, but the only result achieved was the amelioration of pain. Six weeks later, general cerebral symptoms developed and progressed rapidly, with stupor and choked discs, probably due to metastases in the brain. No autopsy was performed.

Remarks.—Prior to the operation in this case the symptoms were regarded as indicating in all probability an extradural tumor, compressing the posterior roots at the first lumbar

segment and later causing a spastic paraplegia from pressure upon the cord. The possibility of a primary growth of the vertebral column was very carefully considered, because of the long duration of pains in the lumbosacral region which persisted throughout the course of the disease. Owing to the complete absence of rigidity of the spinal column, and any constant point of tenderness or pain on jarring, an intravertebral growth (extradural) was regarded as very probable. For this reason, an exploratory operation was determined upon. The prominence of the tenth dorsal spine was so very slight that it did not weigh much in the scales against the practically complete absence of other vertebral symptoms; and severe localized pains over the spine at the level of the tumor, I have had occasion to observe in intravertebral growths as the result of meningeal irritation.

Operation showed that there was an extradural tumor in the vertebral canal which had also compressed the nerve-root of the twelfth dorsal and first lumbar roots, in their respective foraminae, and so far the diagnosis was correct. The small latent growth in the left breast could have easily been detected had a careful search been made, but in the complete absence of subjective symptoms it was overlooked. The case is instructive in that a carcinoma metastasis of the spine may produce a symptom complex simulating very closely that of an extradural growth, in which the symptoms of vertebral involvement are absent or comparatively slight.

CASE XIII (Summary).—*Melanoma of the sacrum, with compression of the cauda equina.*

Onset, September, 1906, with pains in the distribution of the third, fourth, and fifth sacral segments on the right side, followed by paræsthesias, diminution of the right knee-jerk and loss of the Achilles-jerk on the right side. In addition there was deep-seated bone pain and tenderness over the sacrum, the right tuberosity, and the right side of the pubes.

Exploratory operation (by Dr. Woolsey).—Removal of the first, second, and third sacral and fifth lumbar segments, which were found red and softened, and the seat of tumor infiltration.

The patient made a good recovery from the operation, but died two months later, greatly emaciated, with paralysis of the lower extremities and incontinence of the sphincters.

History.—The case was referred to Dr. George Woolsey by Dr. A. F. Warren of Chicopee Falls, and was seen in consultation by Dr. Dana and Dr. Hunt. He is sixty-eight years of age, and is a retired seafaring man. He was admitted to the Presbyterian Hospital on April 12, 1907. The symptoms of his trouble began in September, 1906, with pain in the right perianal region. This pain grew steadily worse and became a constant soreness and aching, so that he was forced to sit almost entirely upon the left side. He had been a sufferer from hemorrhoids for some years, and it was supposed that his pains were due to this cause. An operation for the relief of hemorrhoids was then performed in Chicopee Falls, but after a transient period of relief the pains returned with increased severity, and in addition to the constant aching pain in the perianal region, he also experienced lancinations down the back of the right thigh and over the right side of the buttock. He occasionally has deep-seated pain over the right inguinal region. In the course of a few weeks there appeared paræsthesias in the right perianal region, and the posterior surface of the right thigh. The genitalia also became numb, and he did not have proper control over the sphincters of the bladder or of the rectum. The sexual power has also failed and he is now impotent. There was little or no sensation of urine passing through the urethra and the passage of fecal matter was not attended by the customary sensations. There is some numbness over the left buttock as well. He has lost about 20 pounds in weight during the past few months. In December he commenced to limp badly with the right leg. When the pain is severe, he gets most relief by standing; in the recumbent posture, he lies with the right leg flexed.

Examination (March 5, 1910).—Patient is a small, poorly nourished man, is emaciated, and considerably prostrated by his illness. He is able to stand and walk, and the motor power of the lower extremities is good. The spine is normal in appearance and in mobility. There is a distinct area of tenderness over the upper portion of the sacrum. There is also deep-seated bone tenderness over the right side of the pubic arch, the right tuber-

ischium, and over the middle of Poupart's ligament. The movements of the hip-joint are free and unrestricted; there is no tenderness along the nerve-trunks. The right thigh and right leg are one-half inch less in circumference than on the left side, but the gross motor power is well preserved. The knee-jerk is diminished on the right side, and the Achilles-jerk is lost. The plantar, abdominal, and cremasteric reflexes are all present and normal.

Sensations.—There is a longitudinal strip of anæsthesia which extends along the posterior aspect of the thigh in the distribution of the third sacral segment. The tactile sensibility of the external genitalia and perianal regions is diminished. Rectal examination shows a relaxed sphincter, and, upon the right side of the pelvic wall near the sacrosciatic notch, there is felt a firm nodular body, freely movable, which suggests an enlarged gland. The bony structures are normal to the touch.

Examination of the urine for Bence-Jones albumin yielded a positive reaction on several occasions; at other times the tests were negative.

On March 16, 1910, an exploratory operation was performed by Dr. George Woolsey at the Presbyterian Hospital. The spines and laminae of the three upper sacral and the fifth lumbar vertebrae were removed. On exposing the sacrum, the bone was found to be softened, spongy, and red in color, so that it could be easily scooped out and scraped away with a curette, and was very evidently diseased. The dura mater was incised, and a free flow of cerebrospinal fluid took place. The roots of the cauda equina were found to be normal, and a probe passed up the canal for two or three inches met with no resistance.

Pathological diagnosis of tumor was melanoma.

Note.—The patient made a good recovery from the operation, the wound healing by first intention. After the operation the pain was somewhat less, but the anæsthetic area remained unchanged. He was discharged from the hospital on April 12. Dr. Warren, his family physician, informed us that soon after the patient returned home, the pain increased and the right leg became paralyzed. Later the left leg was similarly affected, and there was complete incontinence of urine. He was unable to assume a sitting posture on account of the very severe sacral pain. He died six weeks after leaving the hospital, greatly emaciated.

Remarks.—It was very evident from the sacral pain and tenderness, as well as tenderness over other bony structures of the pelvis, that we were dealing in this case with a tumor of the sacrum, which had compressed the strands of the cauda equina. The pains were so intense and intolerable that an operation was deemed advisable for the relief of pressure. The result, however, was not very satisfactory.

SURGICAL PAPER BY DR. WOOLSEY.

The technic of operations for the removal of intraspinal tumors first involves a laminectomy. At the outset we must determine whether we will do a simple or an osteoplastic laminectomy. My personal preference is strongly in favor of a simple laminectomy, for as a rule the simplest technic is the best. It gives the best and most free exposure and can more readily be extended in either direction to meet the conditions in a given case. It is the easiest, takes less time and is the safest. It does not essentially weaken the strength or the carrying or supporting power of the spine to remove three to five laminae, for the latter do not bear any weight except possibly to a slight extent in the upper cervical region. This is also borne out by experience. The cord is amply protected by the thick covering of muscles and fascia over the firm theca. Furthermore as, before the removal of the laminae, an attempt is often made to spare the superficial periosteum, more or less of a bony covering may be reproduced. This was not found to be present however in Case III, reoperated one year after the first operation. The spine is somewhat stiff at the laminectomy site but no more stiff, if as much so, as where an Urban or Hartley-Bickham operation is done.

If any form of osteoplastic operation is done the only one I would consider would be that known as Cavicchia's as practiced by Durante. Abbe has employed a very similar procedure in the intraspinal division of the posterior nerve roots for neuralgia and also in operations on intraspinal tumors. It consists of laying back a muscular flap including the spinous processes. Through a slightly curved or angular

incision a little to one side of the median line the superficial muscles are split longitudinally a little to one side of the spines, the longissimus dorsi group of this side is divided transversely at the upper and lower ends of the slit and retracted toward the median line to allow the division of the spines at their bases. The muscles of the opposite vertebral groove are then elevated from the laminæ and retracted, with the severed spines and longissimus dorsi to allow the removal of the laminæ. There is little if any less hemorrhage than in simple laminectomy, in which the hemorrhage is readily controlled. The only bony portions left are the spines, and these can add little if any to the strength of the column. Besides, in the dorsal position the rough bases of the spines are pressed toward the dura and might possibly cause irritation of it. The method therefore seems to me inadvisable and should be discarded in favor of the simple laminectomy. The unilateral laminectomy employed by Taylor in the intraspinal division of posterior nerve roots does not give sufficiently free access for the removal of tumors. Sonnenburg attributed a fatal result from meningitis, due to infection, to the use of Urban's osteoplastic method.

A modified Sims' position on the left side with the patient as prone as possible, is suitable for any part of the spine. The patient should be on the left side, as this is more convenient for the operator, whether the tumor is on the right or left side. Or the patient may lie prone on the belly. The part to be operated on should be flexed as much as possible, to facilitate the laminectomy by separating the laminæ as much as possible and by making the spines prominent posteriorly; and it should be higher than the head and the rest of the spine as well to limit the escape of cerebrospinal fluid when the dura is opened. This position can be quickly obtained in part by lowering the head somewhat in the Trendelenburg position, or, better, by the use of the Lilienthal bridge on the operating table. The use of cushions under the part of the spine to be operated on answers all purposes in most cases. When the operation is upon the cervical region the prone

position, with the head supported on an extension head rest and the shoulders raised so as to allow thoracic and abdominal respiration, is a convenient one.

In view of the fact brought out by Crowe,¹⁴ that urotropin is excreted by the cerebrospinal fluid, fifteen grains of this drug should be administered shortly before the operation, as its maximum concentration in the fluid occurs from one-half to one hour after its ingestion. It should also be continued after the operation in divided doses for several days, giving thirty grains or more every twenty-four hours, on account of its inhibitory effect on the growth of organisms in the cerebrospinal fluid, thus minimizing the danger of meningitis.

In order to determine the position of the incision the spine or spines should be found under whose neural arch the neurologist has localized the tumor. Except in the cervical region it is better to count the spines from above and below, above from the vertebra prominens, below from the fourth lumbar spine, on a level with the highest point of the iliac crests. In patients not too stout we can follow up the twelfth rib to the upper end of the twelfth thoracic vertebra as an additional landmark. It is also convenient to remember that the vertebral end of the spine of the scapula corresponds to the third thoracic spine, for in some cases, where the sixth cervical spine is more, or the seventh less, than usually prominent, it is hard to make sure of the vertebra prominens and to distinguish it from the sixth cervical or the first dorsal spines. When in such cases it is difficult to count the spines accurately, all such accessory landmarks are useful. In operations on the cervical region, after the spinous processes are exposed, it is well to remember that the spine of the sixth cervical vertebra is the lowermost bifid spine of the cervical vertebræ.

If a bed-sore exists on the back it should be thoroughly treated by 95 per cent. carbolic acid, followed by alcohol and then painted thickly with iodine. The area should then be excluded from the field of operation by a light dressing covered with thick gutta-percha tissue fastened to the skin around it by chloroform.

The median incision, having its centre opposite the diagnosed position of the tumor, is carried down directly to the tips of the spines and should be ample, at least 10 cm. and often 15 cm., corresponding to a minimum of three or four spines and often to five or more. A transverse incision through the aponeurosis at either end of the incision may be made to allow of easier retraction of the edges and exposure of the spine, but is not necessary. After dissecting around to either side of the three or more spines exposed, the soft parts are rapidly removed from either side of them by blunt dissection, aided by the knife, down to their junction with the laminæ. It is not necessary to do this subperiosteally. To give more room for the next step, the clearing of the soft parts from the laminæ, the spines may now be cut off at their bases by a bone forceps bent on the flat, after dividing the supraspinous and interspinous ligaments between them, or this step may be deferred until the laminæ are cleared. The latter is accomplished by a periosteal elevator or raspator, by which it is sought at the same time to strip back the periosteum. In freeing the soft parts from the spines and laminæ, there may be considerable hemorrhage, mostly venous, but this is not invariable. This is readily controlled by packing with gauze wet with very hot salt solution alternately on the two sides, as we work on the opposite side. Few if any vessels require the use of forceps or ligature.

When the entire laminæ have been cleared their removal is the next step. This may present some difficulty at first, especially in the thoracic region where the laminæ are more imbricated. The difficulty lies in effecting the first entrance into the canal, the rest is easy. To effect this entrance one may use a Hudson or Doyen burr or a trephine, others use a bone-cutting forceps, and Bickham recommends a Doyen hand saw, for the entire removal of the laminæ. A quick, safe and easy method is to use a rongeur bent on the edge with a flattened lower blade, beginning along the lower border of the laminæ. With the same instrument, or a more powerful one, the laminæ of three or four vertebræ are removed

piecemeal to their outer limit. This is accomplished easily and quickly as soon as an entrance is made into the canal. If a hand saw is used the saw cut must be directed somewhat obliquely inward so as not to saw down into the pedicles. Some use a Gigli saw after an entry is made into the canal, but it is difficult to pass and hence is objectionable. With the use of a rongeur there will be little or no trouble with hemorrhage from the bone, but if the oozing from the bony surfaces is troublesome it may be checked by crushing the surface with a blunt rongeur or the pressure of an elevator, etc., by hot pads or by Horsley's wax. To give room for the operation within the canal and to allow for the possible uncertainty of localization, the laminae of at least three and perhaps four vertebræ should be removed. But it may be preferable to open the dura after the removal of the laminae of two vertebræ to see whether the laminae above or below require removal.

So far the operation has been merely a laminectomy. The ligamenta subflava may adhere to the dura, but are readily peeled off, and the fat surrounding the dura is now exposed. If there is an extradural tumor, it is now exposed if, as is the rule, it lies in whole or in part on the dural aspect. If the tumor is extradural we proceed to remove it, removing as many more laminae in either direction as may be necessary, for extradural tumors, especially cysts, often extend a considerable distance longitudinally within the canal. Care should be taken in separating the tumor from the dura, from which it commonly grows, to avoid injury to the latter, unless on account of its involvement a section of it must be removed. If an opening has been made in the dura with loss of its substance we may try to close it by suturing some of the overlying soft parts to the edges of the defect.

Starr advises opening the dura in extradural tumors, as a secondary growth may be found within it, but it is not often done. Before opening the dura a strong probe or a Horsley dural separator should be used to explore the extradural portion of the canal above or below the opening to make

sure that no extradural cause of pressure exists. The compressing masses of cicatricial tissue, secondary to a healed tuberculous process, which have been removed by Macewen, Trendelenburg and others, are extradural in position.

If no tumor is found extradurally, we expose the dura by pressing back the fat from either side of an incision in the median line and observe whether or not all the dura exposed pulsates. Lack of pulsation indicates increased intradural tension or shutting off of the arachnoid space at or above the point exposed, by a tumor, cyst, adhesions or some other cause. The dura should be palpated before it is opened, though an intradural tumor is not usually demonstrable before the dura is opened, even if it is situated posteriorly. If the dura feels more tense and elastic than usual, a tumor or some other cause of increased intradural tension probably exists. The dura is opened by the point of a knife and slit up and down in the posterior median line, the length exposed, by a pair of fine scissors. Its margins are held apart by silk retraction sutures, forceps or retractors. The cerebrospinal fluid escapes at first to some extent, sometimes as if under considerable pressure, but it offers no trouble by its continued flow, for it quickly ceases if the part operated upon is made higher than the rest of the spine and the head. In my first case, a tumor in the cervical region, I gently packed off the canal above the site of operation with gauze, but this was found unnecessary in subsequent cases even in the cervical region, though in the neck it is not so easy to give the spine a position higher than the rest of the arachnoid fluid. Schede used and spoke highly of Sick's proposal to pass a temporary elastic ligature outside the dura to shut off the fluid by its pressure, but this is more objectionable than packing off with gauze.

After exposing the cord, it is often not an easy matter to say at once whether there is a tumor present or not, or if present what its exact position and limits are. We can say that the cord does not appear normal and is prominent, but we may not be sure whether this is due to an intra- or an

extramedullary tumor. This is an important point and the cause of this difficulty lies in the fact that, in many cases at least, the arachnoid over the tumor is thickened and presents a number of lamellæ, often œdematous, which must be divided until the tumor or cyst, or both, are exposed. Sometimes one finds localized collections of fluid shut in between these thin lamellæ of arachnoid in the vicinity of a tumor, as in Case IV. Spiller, Munro, Krause and others have described encapsulated collections of cerebrospinal fluid which of themselves caused pressure symptoms, without other cause. In Cases II and V, I found a cyst, whose walls were formed by these lamellæ, about the tumor so that on opening the cyst, the tumor was fully exposed, though in Case V it was evident that a tumor was present in a dorsomesial position as soon as the dura was opened.

As a rule the tumor is on the dorsal aspect of the cord. This was so even in Case IV, where the motor symptoms predominated and the sensory symptoms were slight. The tumor may extend laterally or even ventrally as in Case I, so as to require the division of one or two posterior nerve roots. It is always advised to suture such divided roots, but as degeneration occurs in an ascending direction into the cord from the point of section and as no regeneration occurs in the fibres within the cord, I can see no object in such suture. If repair were to be expected under these conditions, the division of the sensory root of the Gasserian ganglion, proposed by Spiller and Frazier for *tic douloureux*, would be useless and the small length of the posterior spinal roots resected to cure intractable neuralgia (Abbe) would not insure against recurrence. Moreover the division of one or even of two posterior nerve roots intraspinally would have no serious effect on the sensation of the part supplied, for according to Sherrington and Greenbaum a given cutaneous area is supplied not by a single nerve root alone but by the root (or two roots) on either side of it, so that it would require the division of at least three successive roots to produce cutaneous anæsthesia. After division of one or two posterior roots the

cord may be gently retracted or pushed to the opposite side to give access to a tumor situated anteriorly.

When the tumor is exposed it is commonly found to be encapsulated and can usually be enucleated with only trifling hemorrhage by blunt dissection by the finger, a pair of forceps, a small scoop, or a Horsley's blunt separator. A few firmer strands of tissue may require division and at times one or more small vessels may require ligation by very fine catgut. The tumor, especially if of any size or of long standing, flattens the cord in a scaphoid manner, by bulging into the central part of the flattened area. The separation of the tumor from the cord is the first step in its enucleation and this may involve the division of a thin layer of tissue connecting the coverings of both. At times the tumor is found to grow from or to be so incorporated with one or more nerve roots (usually posterior roots) as to require their resection. To avoid any additional compression of the cord in enucleating the tumor, it may be wise in some cases to remove longitudinal wedge-shaped pieces from the tumor to reduce its bulk. After opening the dura sponging should be done with the greatest gentleness and care and to clear the field of operation drip irrigation with warm normal saline is preferable to sponging. In order to get above and below some of these tumors, we may have to remove two or three more laminæ. Thus in Case IV it was necessary to remove five or six laminæ to reach the limits of the growth.

Also if no tumor is found we should not hesitate to remove the laminæ higher up, to the uppermost limits indicated by the slightest changes in sensation. Even five or more laminæ should be thus removed if necessary, for there is less danger of a mistaken diagnosis than in failing to find the tumor. If this procedure is too much for the patient, it may be completed after an interval of a couple of days, as has been successfully done. If the tumor cannot be successfully removed, the posterior nerve roots, at and just beyond the level of the tumor, should be divided. This, together with the removal of pressure by laminectomy, would afford great

relief to the patient. If for any reason the cord is to be incised this should be done exactly longitudinally.

The dura should be completely sutured with fine catgut in a round needle to prevent leakage of the cerebrospinal fluid. If a needle with cutting edges is used, I have found (Case II) that leakage may occur through the needle punctures. In only one case (Case V) a small drain of three strands of catgut was left through a small opening of the dura. Some¹⁵ advise incomplete closure of the dura or none at all, to allow free drainage of cerebrospinal fluid. This I consider objectionable unless there is oozing of blood (as in Case V). I have seen the free drainage of this fluid accompanied by a restless irrational condition, which cleared up with the stoppage of the outflow of the fluid. Brodnitz has suggested that it was the cause of the rise of temperature in two aseptic cases and, according to Henle, the free outflow of cerebrospinal fluid has repeatedly been followed by a fatal termination, even without infection. It is always annoying and there is also more risk of infection and of a resulting spinal meningitis, and there is more difficulty in avoiding bed-sores when the back cannot be kept dry. If after the operation there is any evidence or suspicion of an increase of the tension of the cerebrospinal fluid, it may be relieved by lumbar puncture.

The muscles are brought together with interrupted chromic gut sutures to obliterate any dead spaces, and the thick aponeurosis with a continuous suture of the same material. At the lower angle of the wound a small drain of folded rubber tissue is inserted down to the surface of the dura to drain away any blood or serum for the first twenty-four to forty-eight hours. If a suture is tied to the outside end of this, it may be removed by pulling on the suture without disturbing the dressings. For the skin, a continuous button-hole suture of silk answers well, but it should be reinforced by three or more interrupted, figure of eight, silkworm gut sutures through the skin and the edges of the vertebral aponeurosis, which are left in from twelve to fourteen days. This is for the reason that the skin edges are liable to separate,

after apparent healing and the removal of the silk sutures, allowing the wound to open up. This occurred in two cases (Cases II and V) in both of which there was some leakage of cerebrospinal fluid, apparently through needle puncture holes in the dura, as a Hagedorn needle was used in suturing. Whether this was due to delayed union on account of natural slow repair in this situation, or on account of trophic disturbances at the site of the wound, or on account of the constant watery discharges, or to the pressure of the body and the lateral strain in case of restlessness (as in Case V), it should be avoided by the use of reinforcing silkworm gut sutures, which may and should be left in longer than the silk sutures, or by substituting for silk horsehair sutures, which can be left in as long as desired.

In the course of the operation the question may arise whether the operation is to be completed in one or in two stages. In Case III we were compelled to suspend the operation after removal of the laminæ and exposure of an extradural tumor on account of the failure of the pulse and respiration. The patient responded to stimulation, artificial respiration and an infusion of 1000 c.c. of normal salt solution. The use of stimulating and nutritive enemata brought the patient into much better condition than before the operation, so that she underwent the second stage, forty-two hours later, much better than the first. In Case IV, the only fatal one in the series, the operation was long and very difficult, the tumor extending under the laminæ of six vertebræ and being very adherent and difficult to remove from the much compressed cord. I have often wondered whether the result might not have been different had we operated in two stages, though the post-operative condition was not entirely that of shock or collapse. The blood pressure, taken from time to time during the course of an operation, would give an indication as to whether the operation should be suspended and completed subsequently or not. The previous and present condition of the patient, the amount of blood lost and the length of time the operation has already lasted also help one

to decide whether to operate in one or two stages. There is a very decided advantage in completing the operation in one stage. The increased risk of wound infection alone is enough to decide the question in favor of the one-stage operation, if that is possible. Horsley has advised the two-stage operation in cases of brain tumor, but I do not advise it in intraspinal tumors,¹⁶ as Brodnitz, as a routine measure, has done. As an occasional resort in difficult cases or those in poor condition it may be of life saving service. The wound should be temporarily closed. In case we operate in two stages shall or shall we not open the dura in the first stage? Unless the condition of the patient forbids it I would advise opening the dura in the first stage to learn the presence or position of the tumor and the direction in which it extends and to determine whether or what additional laminæ require removal at the second operation. In a recent case operated on in two stages by Dr. Elsberg the tumor appeared at the first operation on opening the dura very much like an intramedullary growth, but at the second operation, the pressure of the cerebrospinal fluid having been relieved for some little time, the tumor was well demarcated from the cord, facilitating its removal. Again in other cases the absence of a tumor might possibly be demonstrated, thus making the second operation unnecessary. The dangers of the opening of the dura, sepsis and excessive loss of cerebrospinal fluid, are preventable ones. It adds but little to the time or shock of the operation. The dura should be temporarily sutured to prevent the leakage of cerebrospinal fluid.

The *mortality* of the operation itself was found by Harte¹⁵ in his series of ninety-two cases (including cysts) to be nearly 47 per cent. Among the ninety-six cases of operations on intraspinal tumors collected by Krause the immediate mortality (within the first twenty-four hours) was 10.4 per cent.; the mortality within the first week 20.8 per cent. and within the first three months 39.5 per cent. Krause gave the mortality 43.7 per cent., and in the last twelve cases 25 per cent. Among the seven cases operated on by the writer, the mor-

tality was 14.3 per cent. This does not include two exploratory operations and one case where the pressure on the cauda equina was due to an endothelioma of the upper sacral vertebræ, in all of which the dura was opened and in all the patient recovered. McCosh has stated that the mortality of laminectomy itself should not be over 10 per cent. Including these three cases the mortality was just 10 per cent.

The chief causes of death are shock and meningitis. The former can be reduced to a minimum by guarding against hemorrhage and operating in two stages, if the laminectomy is not well borne. The shock as a rule is not serious, less so than in operations on the brain. As meningitis is due to infection, it should be avoided by careful technic and the administration of urotropin. Infection is most likely to occur when a bed-sore is present. Hence the presence of the latter makes the prognosis more serious. A bed-sore should be carefully sterilized as described above. Especial care should also be employed in sterilizing the sound skin, in cases where a bed-sore is present, by the free use of Harrington's solution, or by tinctura iodi, used on a dry surface. The danger from the excessive discharge of cerebrospinal fluid is one easily avoided at the time of operation and subsequently by the use of the precautions already mentioned.

The After-treatment.—The patient should be placed at once on an air bed in the dorsal position. As soon as the patient can be moved without much pain, he may be turned on the side for the relief afforded by the change of position. The prone position employed by some is not necessary, neither is any special support for the spine. For the relief of pain in the back and limbs, especially on movement, or of painful cramps, morphine is necessary, perhaps for several days. To prevent the formation of bed-sores the back should be kept carefully clean and dry and if a bed-sore exists its discharge must be kept away from the wound. The latter must also be carefully protected from infection by the discharges from the bladder and rectum. In cases with paraplegia care should be exercised to avoid pressure sores and pressure paralysis.

Thus in Case II there developed a peripheral peroneal palsy, which was due to pressure either on the operating table or in bed. The lower extremities were at the time paralyzed in this case. The drainage should be removed early and the retention sutures left for at least ten to fourteen days. If there is leakage of cerebrospinal fluid this may be diminished and finally stopped by the pressure of a gauze pad over the line of the incision. If moderate in amount it will probably do no harm, even if it continues for some time, but besides being annoying it increases the danger of bed-sores and of sepsis, as long as it continues. Until the incision is healed, it is wise to continue the regular use of urotropin to keep the cerebrospinal fluid sterile.

After the operation patients should be kept in bed for at least three weeks as a rule, but this period varies from two to six or even ten weeks, according to the special conditions present. In some cases, especially in extradural growths and cysts, the convalescence may be very rapid and the necessary rest in bed equally short. Thus in Case III the patient went home fourteen days from the operation. After the disappearance of the pain and hyperæsthesia, massage is of great service in hastening the functional recovery. Electricity should also be systematically used for the same purpose. During the entire course of the after-treatment, the most scrupulous care should be employed in attending to the functions of the bladder and rectum if these are wholly or partly paralyzed. On this may depend the result of the case, and here is where the nursing art is put to its most severe test. It is quite possible to continue for a year or more with continual catheterization without infection of the bladder, but this is a monument to the skill and carefulness of the nurse. Fortunately most of these cases require catheterization for a relatively short time only, but if this is required at all it must be done with the most scrupulous care. Urotropin should be regularly administered during this period also.

Results.—The *immediate result* depends upon the position of the tumor (extradural or intradural), the duration and

degree of its pressure on the cord, and the amount of injury of the cord in the removal of the tumor, in spite of the greatest care. In general, immediately after the operation, there is a decided increase of the paralysis present before operation, especially the motor paralysis, and often a paralysis of parts not previously paralyzed. This is due not only to the slight traumatism to the cord, but also to the consequent œdema. In extradural tumors, this increase of paralysis may be nearly or wholly absent and in them the paralysis is usually promptly recovered from as in Case III, where improvement began on the second day and by the fourteenth all but the finer movements could be slowly performed. In intradural tumors the diminution of paralysis may not commence for two weeks, as in Cases I and II, or a considerably longer time, as in Cases V and VI. When once begun the improvement in motion is usually slow and gradual but may continue for a long time. When the pressure of the tumor has lasted a long time the improvement may be particularly slow. In a case reported by Warren,¹⁷ improvement continued five years or more after operation. Of course if the pressure upon the cord has been severe or long continued enough to cause any degeneration, the muscles supplied by the degenerated cells or the cells connected with the degenerated fibres do not recover their lost power, as neither the cells nor fibres of the cord regenerate. The same also holds in the case of the degeneration of sensory fibres. Where there is no such degeneration the paralyses may be entirely recovered from even when they have been complete or nearly so. Those parts improve first and most rapidly which were last and least paralyzed and vice versa. This is a very strong argument for early operation on all intraspinal tumors. In most reported cases the results would have been better if the operation had been done earlier. Very little time should be wasted in trying antisyphilitic treatment, unless the syphilitic history is very definite. Of course even where extensive degeneration has occurred a successful removal of the tumor arrests the progress of the disease and saves life. The sensory disturbances improve before the motor.

Some pain may persist for a time from the disturbance of the posterior nerve roots, but as a rule the root pain is nearly always speedily relieved to a marked degree. In Warren's case mentioned before, the pain continued for six years, but this is most unusual. Directly after the operation there is often considerable hyperæsthesia but this soon disappears. Passive motion, and later active motion, of the parts paralyzed may for a time occasion severe pains. A spastic condition of the parts most or first affected may persist for a long time or even permanently, owing to a degeneration of fibres of the pyramidal tract, due to the long continued pressure of the tumor, or there may be merely a tendency to cramps. In these cases the deep reflexes remain exaggerated on the side or sides which had been paralyzed.

As to the *ultimate result*, this is favorable so far as my experience goes. Out of the six patients operated on (seven operations), one (Case III) being operated on twice on account of recurrence, none of the five who survived the operation have died as the result of the tumor, with the exception perhaps of Case VI. Although at the time of the second operation in Case III, an absolutely bad prognosis was given, I received a note from Dr. Mailhouse, November 3, 1909, over four years after the second operation, stating that the patient is practically well, doing her own housework, though she has a spastic condition of the left arm and leg due to degeneration of the pyramidal tracts produced by the long duration of the disease prior to operation, and she carries her head stiffly.

This result in spite of the fact that the microscopic diagnosis has usually been some form of sarcoma shows either that such tumors are relatively non-malignant within the spinal canal or that there is a mistake in the pathological diagnosis of these tumors. As an example the tumor in Case I was called a fibrosarcoma by one pathologist and an endothelioma by another. Many tumors formerly called fibrosarcoma are now called endothelioma and the distinction is largely a matter of terms. The length of time that had

elapsed in most cases from the first symptoms to the time of operation is against a high degree of malignancy of most of these growths. It is now quite generally recognized that endothelioma or fibrosarcoma is a form of tumor quite commonly found in the brain and cord, growing most often from the meninges, and showing but little malignancy. According to Starr, intraspinal tumors usually recur, but in nearly or quite half the cases of intraspinal sarcomata in Hartes' table of cases removal insured against recurrence, hence their recurrence is less frequent than that of similar sarcomata elsewhere. In my own cases, Case III recurred but did not recur again after a second operation and Case VI may very likely have recurred.

Except in the case of the thickenings due to a healed tuberculous process, the results of operations on intraspinal tuberculous foci are not so good as those from orthopædic and general treatment, for there is danger of recurrence or of setting up tuberculous meningitis, and the lesion is frequently an inoperable one in the cord. I know of no report of a successful removal of an intramedullary growth. As a result of the laminectomy the spine itself may be somewhat stiff in some cases, in others altogether normal.

The six patients on whom the seven operations were done, which form the basis of the surgical part of this paper, were all seen by Dr. Ramsay Hunt and the diagnosis confirmed or made by him. The first six operations have been published in *The Transactions of The American Surgical Association*, volume xxiv, 1906. They were all operated on in the Presbyterian Hospital.

Case I has also been published in the *Medical and Surgical Report of the Presbyterian Hospital*, volume vi, 1904, and in *The Medical News*, October 1, 1904. The first six and the eighth and thirteenth cases were operated on by Dr. Woolsey.

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INTESTINAL LESIONS PRODUCED BY BLUNT FORCE.

A REPORT OF FOUR CASES.

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WITHIN the past two years there have been admitted to the University of Virginia Hospital four cases of intestinal injury belonging to the class variously designated as "traumatic" lesions, "subcutaneous" lesions, or, as in the title of this paper, lesions by blunt force. The distinguishing characteristic of such cases, familiar of course to all, is the fact that the visceral injury is produced without penetration of the abdominal parietes. Interest in the condition arises from this fact, as also from the comparative rarity of its occurrence and from the problem of successful treatment. That these cases may fairly be considered unusual is evidenced by the fact that most of the reports in the literature are of single instances met with in the experience of various authors, yet they are frequent enough to be far more important than mere surgical curiosities.

In many of the papers reporting cases, and in such reference books as Von Bergmann and Von Bruns' "Handbuch der Practischen Chirurgie," there are elaborate discussions as to the possible mechanism by which such lesions may be produced. Without rehearsing in detail these lengthy disquisitions, suffice it to say that three mechanisms are recognized as giving rise to these ruptures. The most frequent consists in a simple crushing of the gut between a colliding abdominal force and the underlying spine or promontory of the sacrum. The second described method is by bursting. A loop of gut containing fluid or air, and so kinked as to

be temporarily closed, is subjected to severe but unequal pressure, so that it explodes in the direction of least resistance. The third method, perhaps very rare, is by ripping loose of the intestines at their points of attachment, from a forced excursion of the movable parts beyond the limits of normal mobility. Thus the duodenojejunal and ileocæcal regions may be torn by the inability of these fixed parts of the gut to keep pace with the wider range of the small intestine, during rapid forced displacement. This mechanism may be likened to the way in which the cracker may be snapped off a whip. It occurs in falls from a height where the patient lands on the feet or buttocks. Certain particular accidents are prone to cause intestinal rupture, the more common being kicks or blows from the fist over the abdomen, falls from a height, striking flat upon the abdomen on an irregular surface, "run-over" cases, where the wheel passes across the abdomen or back, and crushing of the trunk between heavy objects. There are numerous rarer and some quite curious accidents which have led to the production of the lesion, one such being the forceful contraction of the abdominal muscles themselves.

From the stand-point of the severity of the lesion, cases are classified into contusions, ruptures of some of the coats, and complete rupture. There are authorities, notably W. Körte,¹ who consider contusions and ruptures of some of the intestinal coats as of importance, chiefly from the fact that such lesions frequently cause a later necrosis of the visceral wall and eventuate in a perforation. As Case IV of this series illustrates, there is another aspect of such lesions, namely the development of paralytic ileus from trauma to the intestinal coats in contusions and similar injuries. Further emphasis will be laid on this point later. Obviously the next development of all lesions which cause immediate or delayed perforation is the inception of peritonitis. In small ruptures this outcome may be delayed by the everted intestinal mucosa plugging the aperture. Such cases must be quite rare, and this conservative adaptation of nature is at best but tem-

porary. The nature of the peritoneal inflammation varies somewhat with the position of the lesion. Holes in the jejunum are less dangerous than those in the ileum, because of the relatively low bacterial count of the high intestine.

CASE I (Death).—Patient was a farmer, previously in good health, twenty-six years of age. Seventy-two hours before admission to the hospital he had been kicked in the abdomen by a horse. He immediately suffered intense pain and was so shocked that he had to be carried home. Pain continued without intermission, and with great intensity all over the abdomen, up to time of operation. Twelve hours after injury vomiting began, and continued at intervals. In spite of enemata and cathartics given by his physician, bowels had not moved since onset of trouble. Urine normal. On examination, patient had frank peritonitis, apparently general. There was distention, absence of abdominal respiratory movements, rigidity and tenderness everywhere, movable dullness in both flanks, and obliteration of liver dullness. There was perhaps an accentuation of the rigidity and tenderness in the right lower quadrant. Patient's condition bad. Temperature 103° , pulse 100, leucocytes 10,200.

A right rectus incision, rather low, was made, which immediately disclosed large quantities of free pus in the abdominal cavity. The ileum three feet above the ileocaecal valve was ruptured, the orifice being about 1 cm. in diameter. The abdomen was flushed freely with salt solution and a rubber tube placed in the hole in the gut, being secured by a purse-string and a retention suture. Counter-incisions for drainage were made in each flank; a drain was carried from the first incision to the pelvis, and the rubber tube in the gut was surrounded by gauze. The excess of the wound was hastily closed, patient leaving the table in very bad condition. However, his condition improved greatly after an infusion of salt solution containing 6 drops of 1 to 1,000 adrenalin to the litre. The next morning, temperature was 100.6 degrees, pulse 100, and general appearance good except for restlessness and distention. But in the afternoon, the temperature rose rapidly to 105.6 degrees and the pulse became very rapid and weak. This time there was no response to stimulation, and death ensued 42 hours after operation.

CASE II (Recovery).—Patient was a girl, previously healthy.

seven years old. She entered the hospital 36 hours after falling off a porch. She had struck upon her abdomen, on the angle of an upturned brick, such as frequently are set in the ground as a border about a flower-bed. Immediately after the accident the child suffered intense abdominal pain, and began to vomit within five minutes, continuing to do so until the time of operation. There had been complete constipation since the accident in spite of numerous cathartics by mouth. On examination, the condition was manifestly one of general peritonitis. Thighs were drawn up; abdomen rigid; general tenderness over abdomen; dulness in both flanks; liver dulness obliterated. Temperature 101.4 degrees, pulse 144. No point or area of especial tenderness.

A mid-line incision, the larger part of which was below the umbilicus, was made, and large amounts of free pus at once welled out. A careful search of the abdomen was begun at the ileocæcal valve, and no lesion found until the high jejunum was reached, where there was a rupture, about large enough to admit tip of index finger. The hole was ragged, with everted mucosa about its periphery, and situated near the mesenteric attachment. It was closed with a purse-string suture of catgut, which was reinforced by mattress sutures of the same material. This caused some narrowing of the lumen at the point of repair, but the finger invaginated into the gut above could be carried down through the constricted part without difficulty. A gauze pack was placed to the point of rupture and a liberal drain placed to the pelvis. Flanks were not drained. The wound was rapidly closed, and the child left the table in very bad condition, pulse being 168 per minute.

The patient was treated as are other cases of peritonitis. She was placed in the Fowler position, given salt solution per rectum, which was very well retained, and absolutely nothing by mouth. In addition, subcutaneous infusions of salt were given for the first 36 hours, at intervals of about 12 hours apart. Feeding was resumed very cautiously, rectal alimentation being relied on until the fifth day after operation. Vomiting continued for several days, but rapidly decreased in frequency. The general condition the day after the operation was much better, pulse falling to 110, and the temperature to 100.2 degrees. The bowels moved on the third day. From this time on the patient steadily improved, with occasional slight fluctuations. On the seventeenth

day the patient had another attack of vomiting, following an indiscretion in diet, which subsided promptly after an enema and restriction of food. On the twenty-second day the patient left the hospital entirely well. The wound discharged large quantities of fluid during the first 24 hours. As this diminished the drains were gradually removed, all the original gauze being out by the fifth day. The wound was entirely healed at the time of discharge from the hospital. This patient was recently heard from, six months after her injury, and she is entirely well and has gained considerably in weight.

CASE III (Recovery).—Patient was a farmer, fifty-one years of age, in fair health except for a right inguinal hernia of 14 years standing. Fifty hours before admission, the patient stumbled while walking on his farm, fell and struck his truss, over the inguinal region, against a rock. He immediately felt a sickening pain in the lower abdomen, and collapsed, so that he experienced great difficulty in going the short distance to his house. The pain continued in intensity and became general over the abdomen. Vomiting began several hours after the injury and persisted. There was complete constipation. On examination, the abdomen was found greatly distended; with slight general rigidity, most marked in the right lower quadrant; no dulness in the flanks; liver dulness obliterated. Tenderness everywhere, most marked in the right lower quadrant. Pulse 90 per minute; temperature 100.4 degrees, leucocytes 16,000. In the previous cases a definite diagnosis of peritonitis was made. In this instance, because the injury was so peculiar and because it was thought that at one time peristaltic waves were seen, the possibility of obstruction was considered.

A low right rectus incision was made, and at once gas escaped from the peritoneal cavity, and turbid fluid was discovered, especially in the pelvis, where there was quite an accumulation of pus. The appendix was normal. The intestine was then traced upward, and a foot above the ileocaecal valve was found an opening, opposite the mesentery, about 1 cm. in diameter. As this was pulled up faeces and gas escaped, as though the hole had become for a time occluded by the damaged loop sticking to another loop, or to the parietal peritoneum. The aperture was closed with fine black silk sutures. The pelvis and right lumbar fossa were drained through the original in-

cision, and packs were carried to the sutured spot in the bowel. A counter-incision was made for drainage in the left flank. The patient stood the operation well.

Second operation: Obstructive symptoms developed, and three days after the first operation it became necessary to do an enterostomy just above the point of rupture. The fecal fistula thus formed drained profusely, relieving the obstructive symptoms, but causing infection of the abdominal wall and extensive ulceration from the digestive action of the discharges. The patient meanwhile was passing some of his intestinal contents through the normal channels.

Third operation: After the patient had been relieved of several slight obstructive attacks by simple restriction of diet, the enterostomy was closed, three months after the first operation. The ulcerated area is now healing well and there is no leakage of intestinal contents. The patient is practically well, being about in a chair, and remaining in the hospital simply for convenience in having the healing wound dressed.*

CASE IV (Recovery).—Patient was a colored boy, fifteen years old, previously entirely healthy. While he was standing between an open gate and its gate-post, a cow had charged violently against the gate, crushing the boy against the post, and forcibly driving a part of the gate against the abdomen just to the right of the umbilicus. This occurred 101 hours before admission. Immediately after the accident, there was sharp abdominal pain, collapse, and free vomiting. The pain at this time was described as general over the abdomen, although most intense just to the right of the umbilicus. The attack of primary vomiting soon subsided, and there was no further vomiting,—a peculiar feature of this case. Distention increased gradually, constipation was practically absolute. There was no nausea to indicate reversed peristalsis. On admission, the clinical findings were as follows: abdomen greatly distended, but not rigid; no visible peristalsis; tenderness general but not marked; no

* This patient, Case III, died six weeks after sending this paper to press. At his death the surgical results were apparently entirely satisfactory. There was no fecal fistula, no obstruction, no peritonitis. So far as could be learned, death resulted from a general asthenia, the patient never becoming very strong, and the end coming quite suddenly and unexpectedly.

muscle spasm and no masses felt. On percussion, there was general tympany, and no movable dulness discovered. Pulse good, 110 per minute; temperature (rectal) 101 degrees, leucocytes 4,000. The absence of rigidity, free fluid, leucocytosis, or marked tenderness made against peritonitis, and hence against ruptured bowel. The absence of signs of hemorrhage pointed against rupture of the liver or kidney. A diagnosis of adynamic ileus from trauma was made.

First operation: A mid-line incision, chiefly above the umbilicus was made, and at once there was a gush of old blood. This was not very great in amount and was soon mopped out. There was no soiling of the peritoneum. The upper intestine, greatly distended, was picked up and traced downward. After passing down a number of feet, a loop was reached which presented marked signs of injury. There was no perforation, but over an area about 14 cm. long, the gut was contused, its serous coat ragged and rough, and the muscular wall infiltrated with old extravasated blood. This loop oozed when handled and was considered the source of the free blood above mentioned. Below this area the intestine was flat, collapsed, and empty, presenting a marked contrast to the distended condition above. A further search, hampered by the ballooned gut, revealed no other lesion. The injured area was 5 or 6 feet above the ileo-cæcal valve. An enterostomy was made immediately above the traumatized area of the intestine, a tube being inserted into the lumen of the gut.

Second operation: The tube placed in the intestine, as just described, never drained. The marked distention of the abdomen became even greater, but there was still no nausea nor vomiting. Apparently all peristaltic movement, normal or reversed, had been reflexly inhibited. Eserin and pilocarpin administered repeatedly in large hypodermic doses were without effect. Another operation was done, four days after the first, with the idea of relieving any possible kinking around the tube. No cause, other than lack of motive force, could be discovered to account for the lack of drainage. A solution of eserine (1 mg. to 2 c.c. of salt solution) was applied to the serous surface of a loop of dilated gut without causing any contraction whatever. To relieve the distention, a large amount of the gas and fecal contents of the paralyzed gut were manually emptied out. This time, in clos-

ing, instead of putting in a tube, the loop of gut already opened was packed outside the abdominal cavity in gauze. On the third day following this second operation, the enterostomy began to drain fecal material for the first time, on the eleventh day after the original injury. There was rapid relief of distention, and marked general improvement in the patient's condition.

Third operation: This consisted simply of the closure of the fecal fistula two weeks after the second operation. A resection, with lateral anastomosis, was performed, the only noteworthy feature of which was the difficulty encountered from adhesions. After this, the patient's convalescence was comparatively uneventful. He was discharged in very good condition, forty-three days after admission to the hospital.

In reviewing these cases one fact is especially worthy of emphasis. All four patients were brought in late in the history of the illness, the shortest intervening period since injury being 36 hours. The reason for such delay is in part explained by the fact that this hospital draws many of its patients from a widely spread rural population. Two important features of our cases depend upon this delay. In all of them, the development of abdominal and general symptoms had proceeded so far that the existence of a condition imperatively demanding a laparotomy was very manifest. If, however, the long interval following injury made the diagnosis and method of treatment matters of easy decision, for the same reason the successful prosecution of treatment was rendered all the more difficult. The experience of others lends weight to these assertions.

All authorities emphasize the difficulty in deciding upon the presence of a visceral lesion in the first hours following injury. In nearly all severe abdominal insults, whether or not they be associated with damage to the deeper structures, there is rapidly developing shock, usually associated with intense pain and vomiting. This condition may last for a number of hours. If there has been rupture of a hollow viscus, with ensuing peritonitis, the primary shock may merge into the latter condition without a perceptible demarcation. On the other hand, the symptoms of peritonitis may be delayed, appearing

some time after shock has subsided, and following an interval of marked seeming improvement. The difficulty of the situation in cases seen early is therefore quite evident. Is the patient simply suffering the symptoms inseparable from a severe contusion of the abdominal wall, or has he already passed from the primary shock of the trauma into the peritoneal disturbance following on ruptured gut? Or, again, the first severe upset from the accident has subsided somewhat; but is this to be a progressive return to normal, or is it merely an interval of quiescence before symptoms of a spreading peritonitis appear? The most important and difficult step in the handling of such cases lies just here. To wait for the development of distention, rigidity, the obliteration of the liver dulness, etc., is to throw away the great advantage of early intervention, before the general peritonitis, which causes these symptoms, has been established. Andrews² even advises against waiting for successive hourly leucocyte counts, and with wisdom. To overcome the difficulty various writers lay emphasis on various clinical observations. The cardinal symptoms of pain, tenderness, muscle spasm, shock, and vomiting may be quite as pronounced in severe parietal trauma alone as when visceral lesion is associated, hence subsidiary points have attracted attention in the effort to determine the presence of an injury to intestine, etc. Thus Munro, in Keen's "System of Surgery," cites Perez³ as laying great stress on the value of continued, rapid and superficial breathing. In the same article, Mauclaire and Roger⁴ are quoted as believing the injury to be serious when the muscle spasm and tenderness rapidly become general over the abdomen, and do not remain confined to the area of injury in the early hours after its occurrence. These points have failed however to impress the majority of observers with their importance. Indeed Bottomley⁵ after analyzing an equal number of cases of abdominal injury, with and without visceral lesion, found that shock, pain and vomiting varied in individuals in the early hours, irrespective of the nature of the lesion, and that many cases could only be decided by exploration. In fact, this is the opinion of practically all recent writers on the subject, and

emphasis is laid on the necessity for exploring all cases of trauma of the abdomen by blunt force sufficiently severe to arouse the suspicion that the viscera have suffered. It is urged, and with reason, that the additional assault of the anæsthetic and exploration on a person already suffering from shock—who may not have internal injuries—is decidedly less to be avoided than the chance of permitting a ruptured gut to leak unrestrained, until it shall have given rise to sufficiently outspoken symptoms to make the nature of the injury evident. This necessity for exploration has not, we feel, been sufficiently impressed upon the medical profession in this country. The lack of appreciation of this necessity on the part of our patients' physicians is a decidedly more potent factor in the delay elapsing before they come to us, than is the number of hours travel that separate them from us. The difficulty of diagnosis is easily appreciated from the facts already presented, but this difficulty in itself should make all the more evident the wisdom of immediate consultation with a surgeon and exploration in most instances.

Cases which are seen somewhat later usually are easier to diagnose. The persistence for hours of vomiting, or its recurrence after an interval of cessation, is an important indication that there is more than a superficial contusion. The same is true of the persistence and increase of rigidity, tenderness, and distention. When these findings are supplemented by obliteration of liver dulness, fluid in the flanks, fever, leucocytosis, etc., we have of course an unequivocal picture of peritonitis, which with the history of trauma, makes the diagnosis of subcutaneous rupture of a hollow viscus almost certain. The only other condition which could cause doubt would be the rupture of some parenchymatous organ, like the liver or spleen, with hemorrhage into the abdominal cavity. Such a lesion would usually be associated with anæmia, restlessness, thirst, low red corpuscle count and the other signs of concealed hemorrhage. The two lesions are so closely related in their cause and treatment, that they may really be considered as belonging to the same class of cases, and therefore not further discriminated.

In those cases seen later, the treatment is the same as in the group of early cases previously discussed; namely, exploratory laparotomy. The difference lies only in the fact that the indications for operation now are much clearer, the operative procedures required more difficult and time-consuming, and the prognosis much more grave. To the general statement that all these cases should be operated, there is but one exception; namely, where the patient is already moribund. Even here refraining from operation should be carefully considered, because as Case II reported in this paper and experience with peritonitis of other origin in many other instances has shown, the rule of never giving up hope is a pretty good one. At any rate the operator gives his patient the benefit of a chance by interfering, whereas such a case left to nature is equivalent to an admission of defeat.

The chances for a successful termination without operation are practically *nil*; with operation, the chances vary inversely with the period intervening between the receipt of injury and the time of intervention. Thus Petry⁶ collected 42 cases, of which 18 were operated in the first 24 hours, with success in 44.5 per cent.; whereas of the remaining 24 cases operated later than 24 hours, 75 per cent. were lost. A summary of Brunner's statistics shows that within the first 10 hours a majority recover; from 10 to 20 hours, the chances are even; and after 20 hours there is a rapid increase in the percentage of cases lost. It is admitted that this probably represents too favorable a view of the results, as more successful than unsuccessful cases are apt to be reported and collected. The force of this stricture is seen by comparing Brunner's figures with those of Berry and Giuseppi⁷ collected from the records of 10 London hospitals for a period of 15 years (1893-1907) and embracing in all 132 cases. Of these, 48 cases were not operated and all died. Seventeen of 84 cases operated were saved, 12.8 per cent. of the total number of cases. No case recovered when operated upon more than 28 hours after injury, and only two when operated more than 12 hours after injury. These figures speak with sufficient eloquence for the importance of early operation. It

will be noted that the latest of our peritonitis cases died, and the earliest made the easiest recovery.

There is, of course, another factor in the question of mortality than the simple one of time, and that is the value of the therapeutic measures invoked. The great improvements inaugurated in the last few years in the treatment of general peritonitis show their effects very clearly in this group of cases. These improvements are familiar to the entire surgical world as the Fowler-Murphy method, and may be summarized briefly as the elevated posture, the rigid restriction of everything by mouth, and the administration of fluids in small amounts and at frequent intervals per rectum. We feel that to this we owe the recovery of two of our cases long after the deadly time-limit of 28 hours of Berry and Giuseppe. That this is probably true, is further suggested by finding other successful late cases (Legnani,⁸ Poncet⁹) in the literature of the last three years.

The repair of the local damage depends upon its extent. A small hole is best closed by sutures; a large lesion may be best handled by resection and anastomosis, if the patient be received early and in good condition; otherwise by enterostomy. This is really a matter of subsidiary importance, provided its execution is not so difficult mechanically as to prolong the operation unduly. The essential question is the successful treatment of the peritonitis, the extent of which depends largely on the duration of the condition. In all of our cases it was quite general. It is our practice to drain the pelvis, the site of the lesion after its repair, and sometimes the lumbar fossæ. Then the patient is put almost upright in bed, rectal administration of normal saline solution is started, and usually a subcutaneous infusion. The weight of authority, in all but some of the recent publications, urges the use of free irrigation of the abdominal cavity with sterile normal salt solution in large amounts (30-50 litres). It is the experience of this clinic that better results are obtained without such irrigations, unless there be gross soiling with fæces, undigested food, etc. It may seem unnecessary to protest against the giving of cathartics to these patients, but our cases testify to the con-

trary. In the second case, a number of doses of salts escaped promptly through the perforation in the jejunum, and were found along with many other things in the pelvis. As to the convalescence, there is nothing requiring remark as different from that of peritonitis cases in general, except to point out that some vomiting is to be expected, perhaps for a number of days, and that one should be on guard against a secondary obstruction.

So far, this paper has consisted chiefly in a consideration of the possibilities resulting from rupture of the intestine. Three of our four cases involved this lesion, and the great majority of reports in the literature are of such injuries. Our fourth case presents certain *interesting features* which are deserving of individual comment, best made in separate paragraphs from those devoted to a consideration of rupture. Although the etiological factors of intestinal contusions, such as Case IV presents, may be identical with those causing rupture, and indeed a contusion may later become a perforation from the necrosis of the injured areas, nevertheless the clinical picture and necessary treatment of such a case as Case IV presents distinct differences from Cases I, II and III. The pathological development, in the two groups, of course proceeds along very different lines. With the establishment of a rupture, peritonitis ensues; there follows inevitably the evidences of the local inflammation with the constitutional signs of rapid toxic absorption. When a contusion, as in our last case, causes a local paralysis of the intestinal musculature, with a consequent ileus, there follows naturally the syndrome indicative of obstruction. It would be a work of supererogation to elaborate here the typical descriptions of peritonitis and intestinal obstruction. The slower development, lower leucocyte count and better general condition of the patient in obstruction will usually help in the diagnosis as well as the local differences in abdominal signs and symptoms. But while it is possible that some obstruction cases arising from blunt intestinal contusions may present the typical appearance, ours certainly did not. Nausea and vomiting, most characteristic features of obstruction, were strikingly absent after the first

hours. The allied symptom of sharp colicky pain, and the accompanying sign of visible peristalsis were also not discovered. These peculiarities occasioned some difficulty in making a diagnosis, but in looking back over the case, it would seem highly probable that the contusion of the gut not only caused a direct paralysis of the area damaged, but also resulted in a reflex suppression of peristalsis throughout the small intestine. In no other way is it easy to explain the curious clinical symptoms and operative findings. The wonderfully good condition of the patient during the long interval of adynamic obstruction (ten days in all) is worthy of comment. So also is the utter failure of the administration of pilocarpin and physostigmin to reestablish peristalsis. With the renewal of this function the case presented then simply the common problem of closing a fecal fistula.

Although rupture is more frequent and results in a more fulminant disturbance, the occurrence of paralytic obstruction from blunt force presents essentially the same problem. That is to say, such lesions demand, in our opinion, exploratory laparotomy and the appropriate handling of the obstruction. In early cases, with active peristalsis above the damaged loop, a lateral anastomosis, with resection of the injured area, is perhaps indicated. In an instance such as ours, of four days standing and with no evidence of muscular action in the gut, the requirement would seem to be immediate establishment of an enterostomy, with the mechanical removal of as much gas, fecal matter, and intestinal secretion as possible. One very definite result of this procedure is to relieve the great distention of the obstructed bowel, which contributes much toward aiding the return of peristalsis. This relief of tension is in itself sufficient argument against the view which some might advance, that nature should be left to take care of the case. Admitting that the contusion may subside and the damaged loop once more take up its function and thus relieve obstruction, it is very doubtful if this would occur were the overdistention not relieved.

In conclusion, there are a few details concerning these injuries, which should be mentioned for the sake of complete-

ness. These accidents are most frequently met with in males during youth and early manhood, and in females during childhood, these of course being the periods of greatest exposure to trauma from the habits of life. Preëxisting lesions, such as hernias, ulcers, adhesions, etc., of course increase the liability of rupture should trauma occur. Our third case is an illustration of this statement. Lax abdominal muscles afford less protection than a wall which is contracted, and hence very sudden accidents are more frequently the cause of visceral lesion than those in which the patient has some warning. All parts of the gastro-intestinal tract have been injured, to say nothing of the other abdominal viscera, but the ileum and jejunum are more often involved, the colon and stomach less frequently. Thus in 219 cases, the small intestine was affected 172 times, the large 26 times and the stomach only 21 times. Lesions of course may be multiple, or may be associated with rupture of other organs. We are inclined to feel that vomiting is apt to arise sooner if the lesion be above the level of the umbilicus than if it be below. Thus Case II began to vomit almost immediately, whereas in Case I and Case III there was quite a pronounced interval before vomiting commenced.

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⁹ Poncet: Contusion de l'abdomen; perforation intestinale; enterectomie au 4e jour; guérison. Lyon Méd., 1907, cviii.

TRANSGASTRIC JEJUNAL FEEDING.*

AFTER GASTRO-ENTEROSTOMY COMBINED WITH GASTROSTOMY. TESTED IN A
CASE OF ARTERIOMESENTERIC ILEUS.

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THE problem of feeding a patient suffering from a very vulnerable open gastric ulcer has many a time been under discussion and the advice to resort—in a desperate case—to a jejunostomy had remained as the only help, though little satisfactory, first because an external fistula of the small gut has the tendency to very troublesome leakage (a point which, however, can be avoided by a good technic); second, dangerous adhesions and kinks in the bowel may be formed; third, a speedy emptying of the acid gastric juices, the most important element for the cure of the ulcer, is not influenced by it; and finally, on account of this latter an operation must follow later on in most of these severe cases. It may be said, however, that when the food is taken by mouth in the normal way, the gastric juice is by far more freely secreted than by any other ingestion. In extragastric feeding HCl is therefore to be expected only to a moderate amount in the stomach. Experience has taught, that in the long run feeding by a gastrostomy fistula is mostly insufficient, and that the patient slowly loses ground by it. It can thus be concluded that by jejunal feeding the nutrition suffers much more, because the presence of chyme in the duodenum is of great importance for the secretion of the pancreas. A jejunal fistula can therefore only be of great use when we have to tide the patient over a starvation of a number of weeks, but there it does infinitely more than rectal feeding. I had concluded that in a case of

* Read before the Western Surgical Association, Omaha, Neb., December 20, 1909.

severest gastric ulcer, where gastro-enterostomy and in addition a jejunostomy seem desirable, a better result could be obtained by a modification of these operations for drainage and for extragastric feeding. This modification I had a chance to try in a case of duodenal obstruction with a most rebellious stomach. This patient does not exactly belong to the group of cases spoken of, but shows the possibility of usefulness of this procedure in different conditions. The case is through a number of rarer occurrences interesting enough in itself to be related in detail.

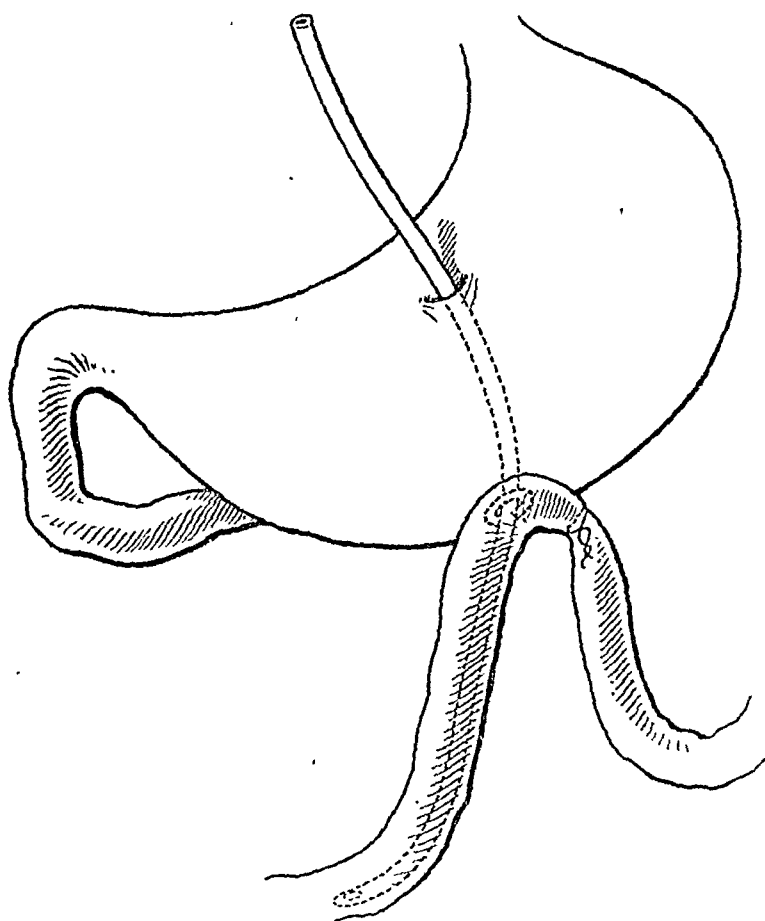
Sr. S., nurse in charge of one of the floors at St. Joseph's Hospital, aged 23 years, who had been in splendid health up to the end of 1907, began to look thinner after that time. She was suffering from very little pain but could not eat solid food, and during February and March, 1908, was living practically only on buttermilk and even had to gradually reduce the quantity of this latter.

On April 6, 1908, I first saw her, and she remained under my observation until April 23. During this time there was frequent vomiting, and at times the vomitus contained blood. Abstinence from food lessened the amount of vomiting but did not produce complete cessation. The blandest ingesta in minutest amounts were vomited up very shortly after being taken. The pulse ranged from 50 to 80; temperature, from 98 to 99³/₅. All suggestions of surgical interference were rejected until April 23, when permission to operate was granted. Preliminary to the ether narcosis, one-sixth grain of morphine with $\frac{1}{150}$ gr. atropine was given hypodermically. On opening the abdomen the stomach appeared slightly ballooned, and also the upper duodenum, the pyloric ring being wide. At the lower end of this dilated part of the duodenum a broad, very firm band of adhesion unites the duodenum with the gall-bladder. The tense gall-bladder is found to contain small stones. The gall-bladder was dissected free. The lower ducts were normal. A drain in the gall-bladder was led out through a stab wound in the right border of the ribs. Air pressed through the lower duodenum by compressing the stomach seemed to pass. The experiment, however, is not beyond doubt. Further exploration of the abdomen revealed an adhesion

of the omentum to the abdominal walls at a point a little below the level of the spleen. This adhesion was divided. The bulk of the omentum was fixed in the pelvis and could not be moved upward, as if broadly adherent. The abdominal walls were tightly stretched and pressed toward the vertebral column (the narcosis then not being complete). We were struck by the lack of space anteroposteriorly in the umbilical region. After forcible forward retraction of the abdominal walls the omentum was gradually drawn out of the pelvis. It was not adherent but was very bulky. The transverse colon was long and large and had also been lying below the promontory. The small intestines were entirely collapsed and contracted. The condition suggested arteriomesenteric ileus. The omentum was brought into contact with the wound and one stitch caught it in the lower angle to hinder its returning to its former position. The abdomen was now closed. Right after the operation the respirations were 12; pulse 88. Two hours afterward the respirations had slowed to 8 per minute, and soon afterward to only 4 per minute. Next morning pulse weak and irregular—122. Vomiting became continuous and considerable blood was noticeable in the vomitus. The vomitus was composed of liver and pancreas secretions.

I determined now to combine a gastro-enterostomy with gastrostomy and pass a gastrostomy tube through the opening in the anterior wall of the stomach and across the stomach through the gastro-enterostomy opening some distance into the jejunum. By the use of a rather large Murphy button a rubber catheter could be passed through its opening into the lower arm of the jejunal loop, and since this catheter would nearly but not tightly fill the lumen of the button the tendency would be to retain the infused food in the intestine, though some drainage was possible along the tube and through the side walls of the button for the gastric and other regurgitated secretions. In accordance with these purposes the wound was reopened. The omentum again seemed to be down into the pelvis. It was raised up, and with as little eventration as possible the first part of the jejunum was secured and an antero-inferior gastro-enterostomy was done, the smaller half of the button being inserted into the stomach. Then a good distance from the gastro-enterostomy opening a tiny opening was made into the stomach wall, just enough to make it possible to force a soft catheter through, which was however

rigid enough so as not to double up too easily, and thus not to have its jejunal end eventually expelled back into the stomach by the collection of a greater quantity of food in the gut. This catheter was brought out through the gastric half of the button, then inserted into the lower half, and now the button was closed. The catheter was pushed in far enough to reach about 10 or 12



cm. beyond the button into the lower loop of the jejunum.¹ The button seemed a little large for the gut, and therefore in order to support the line of union a continuous silk Lembert suture was applied over the two anterior thirds of the circumference. Two silk pucker-strings inverted the stomach walls around the catheter,

¹ If instead of the button I had used the suture method the tube would better have been pushed even farther down into the jejunum and a very thin and soft tube would have been preferable.

the inner one catching the catheter, the outer one being fixed to the fascia of the abdominal walls, which were now closed by figure of 8 silkworm sutures.

The operation, including the closure of the wound, took 35 minutes. Before taking the patient from the operating table 12 ounces of thick malted milk were administered through the tube into the jejunum and coffee and water per rectum. The pulse shortly before the operation was 132, the respirations 8 per minute. After the operation the pulse was 144; respiration 5. Half an hour later the respirations were 4 per minute; then at 10.30 P.M. only 3 and at 10.45 only 2 respirations were observed per minute. Some blood was then vomited. Every hour 3 ounces alternately of strong malted milk and beef tea were given into the jejunum. In the night the temperature went up to $101\frac{2}{5}$ by axilla, but after a very heavy sleep it was evident by morning, that oil had been added to the lamp. The next day, April 25, at 8 A.M., pulse 110; respirations 7 per minute. Now a new trouble came. At 11 A.M. the patient began to complain of very severe pain and vomited a large basin full of dark green fluid with apparently a very small quantity of the injected food. An hour later again such copious vomiting and very frequently during the afternoon, so that the feeding had to be stopped. The gall-bladder drainage yielded only very little bile. Late in the evening after severe pain in the stomach again a large amount of dark green fluid was vomited. The pulse however had come down to 93; the respirations were 13, and the night was good.

The next morning (April 26) we tried to counteract the vomiting in assisting drainage by having the patient repeatedly sit up for 10 minutes with a back rest, though she was extremely weak. The copious vomiting, however, of greenish fluid kept up. No particles of food were seen in it. It was evident that we had the picture of acute dilatation of the stomach with that well-known abundant secretion into the stomach; this picture was however previously modified by the prompt vomiting and now by our drainage. Could for such cases the cause lie simply in an obstruction of the lower duodenum, the copious fluids being perhaps only moderately increased or even normal quantities of stomach, duodenum, pancreas, and liver secretions combined? The quantity of these four secretions has been found to be much larger than we formerly thought, and to be nearly equal in 24

hours to the individual's volume of blood and lymph together. Stomach washing relieved the patient greatly for some time. The jejunal feeding is kept up, but hardly any pressure allowed. The fluid in the irrigator is kept at a level with the pit of the stomach. For a larger feeding one hour is often required, and no food is administered if after removing the clamp on the feeding tube there is escape of any amount of the formerly ingested food. There is however no discharge of malted milk from the tube one hour after giving 4 ounces, while one-half an hour after the feeding a little appears on removing the clamp. Cream is added to the malted milk. Either the stomach has very poor contracting power or stomach contents, slime, etc., have blocked the small amount of space left in the Murphy button, or both factors combine to the effect that apparently all the secretions in the stomach must be washed out or vomited. Cascara with the feeding causes several defecations. The feeding through the catheter becomes severely distressing; the nausea, vomiting and weakness produce again a very miserable condition.

I then inserted on the third day after the second operation a stomach tube and removed about 10 ounces of bile-stained fluid. Considering this to be digestive secretions it was now mixed with 7 ounces of thick malted milk, 3 eggs and some salt and was infused into the jejunum. The same was done in the evening of the same day and twice the next day. This seemed to produce a very favorable change. Four and a half days after the second operation the patient was given buttermilk in sips by mouth and retained it all. The feeding, mixed with the gastric secretions, was kept up twice daily. The tube leading to the gall-bladder was removed on May 4. The patient had by this time begun to complain so much, that feeding in any way became almost impossible and had to be greatly reduced. On May 6 the pulse ran high, up to 160 and 168 with a temperature of 101. The patient was most dilapidated, wanted to be left alone to die. We feared that the comparatively large button made part of the trouble, large quantities of blood having appeared in the stools, but it seemed necessary that the feeding be pushed. One quart of cream and milk, 3 heaping tablespoonfuls of sugar were then given by the tube and at the same time the stomach washed and a moderate regurgitated portion of the feeding thus removed. This was repeated every 8 hours.

The next day pulse very weak—130 to 150. Feeding kept up. When food was vomited, it was given again by the tube. On May 10 she began again to eat a little. On May 11 she was taken out into a chair. On May 12 she ate so nicely that feeding through the tube was omitted. The patient was from then on up every day and began to feel better and gradually stronger. The tube was removed from the stomach 3 weeks after the operation; the button did not pass until 60 days after the operation. This I think was due to its large size. The first weighing 8 weeks after the operation, gave 88 pounds, while the patient had weighed 156 pounds before the sickness.

Now, one and a half years after the operation, the patient is looking well, weighs 121½ pounds, has no complaints except that, when she was greatly overworked, she vomited a few times. She is again in charge of one of the hospital floors.

Contrary to Laffer's views in the ANNALS OF SURGERY (March and April, 1908), arteriomesenteric ileus has to be considered as an established pathological condition. Two elaborate publications in support of this have appeared this year: Nakahara's, from Enderlen's clinic in the *Beiträge zur klinischen Chirurgie*, Bd. lxiv, Heft 1, and lately V. Haberer's from V. Eiselsberg's clinic, in the *Archiv für klinische Chirurgie*, Bd. lxxxix, Heft 3. Haberer in reviewing the literature says, that no case, where all other means were fruitless and where therefore surgery had to be resorted to, had as yet survived.

It may be that this combination of gastrostomy with gastro-enterostomy and transgastric jejunal feeding will be of use in some of these and similar conditions.

After the gastro-enterostomy is done, the additional gastrostomy with the insertion of its tube into the jejunum is of course a very simple affair and adds certainly much less to the operative trauma than the somewhat bulky title of the paper would lead us to presume.

THE PROPOSED FISTULO-ENTEROSTOMY OF VON STUBENRAUCH.

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It has doubtless been the experience of most surgeons of large practice to meet one or more cases of persistent post-operative biliary fistula in which the conditions known from the preceding operation argued against the success of a secondary cholecystenterostomy or choledochenterostomy. Numerous procedures have been proposed for the relief of this distressing condition, the most promising of which are the fistulo-enterostomy of V. Stubenrauch¹ and the choledochoplasty of Sullivan.² Neither of these has been tried by its author on the human subject, though both have given promising results in animal experiments.³

It has been the author's pleasure to follow a case on the service of Dr. J. F. Binnie in which the V. Stubenrauch procedure was carried out. Since, so far as we have been able to ascertain, this is the first application of the method to the human subject, it has been deemed advisable to publish this brief description of the operation and its results.

The patient, a woman of fifty-seven years, came to operation because of persistent and progressive jaundice, coupled with digestive disturbances, loss of weight, and tenderness over the

¹V. Stubenrauch: Ueber plastische Anastomosen zwischen Gallenwegen und Magendarmcanal zur Heilung der completeen äusseren Gallen-fistel. Arch. für klin. Chir., lxxix, 4 S. 1025, 1906.

²Sullivan, A. G.: Reconstruction of the Bile-ducts, Journal A. M. A. Sept. 24, 1909, vol. liii, pp. 774-777.

³Since the preparation of this article, Dr. Geo. E. Brewer has reported a case in the human subject in which the method of Sullivan was used with at least temporary success. Brewer, Geo. E.: Hepaticoduodenal Anastomosis, ANNALS OF SURGERY, li, 6.

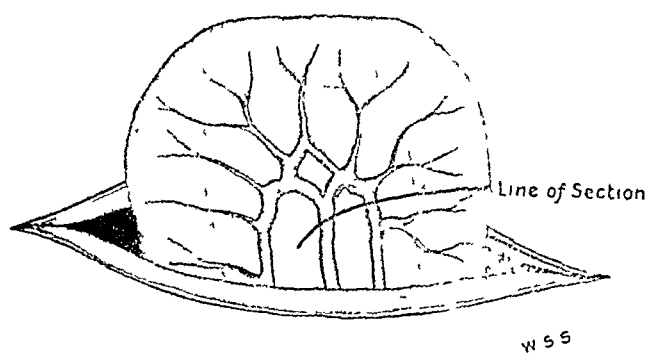
gall-bladder region. The usual incision exposed a long Riedel's lobe extending far below the normal hepatic margin, and under this a green, slightly thickened gall-bladder, showing a moderate number of adhesions to the great omentum and hanging well down toward the pelvis. The gall-bladder was opened and a considerable quantity of tarry bile was evacuated. The common duct, which was larger than the forefinger, also contained tarry bile but no stones. This was opened to facilitate exploration and a tight stricture was found in the lower part, due to a tumor of the head of the pancreas. There were no enlarged glands in the neighborhood and the condition was regarded as chronic pancreatitis. The abdomen was therefore closed with gall-bladder and choledochus drainage. The tubes were removed in about a week, after which one of the sinuses rapidly closed while the other—later proving to be the gall-bladder drain—continued to discharge a good quantity of normal bile. The jaundice gradually disappeared but the stools remained acholic. At the end of four weeks this was still true, and the patient was told that the biliary discharge from her abdominal sinus would probably be permanent. This caused her great distress, and she expressed in strong terms a desire to have the benefit of any procedure which might offer her relief. It was therefore decided to try the efficiency of the proposed procedure of V. Stubenrauch, which uses a diverted segment of gut as a canal to carry the discharge from a biliary fistula back into the intestinal tract.

The operation was as follows: The abdomen being opened by means of a vertical incision below and slightly median to that of the first operation, a loop of ileum about eight feet from the cæcum was picked up and brought out through the wound. This was divided between clamps in the usual manner, the incision being carried into the mesentery for about three inches in such a direction as to preserve the blood supply of both portions of gut (Fig. 1). The proximal end of the distal segment was inverted with a temporary purse-string while the distal end of the proximal segment was united end-to-side with the distal segment, as far as possible from the line of section (Fig. 2). The mouth of the fistula was then cleaned as thoroughly as possible and its edges excised. A subcutaneous track was burrowed in the superficial fat from the upper extremity of the wound to the opening of the fistula; and through this was drawn

the blind end of the diverted gut-segment (Fig. 3). This free end was allowed to protrude a short distance and was tightly tied with a strong ligature so that it might slough open in the course of a few days. The operative wound was closed without excessive pressure on the emerging gut-segment.

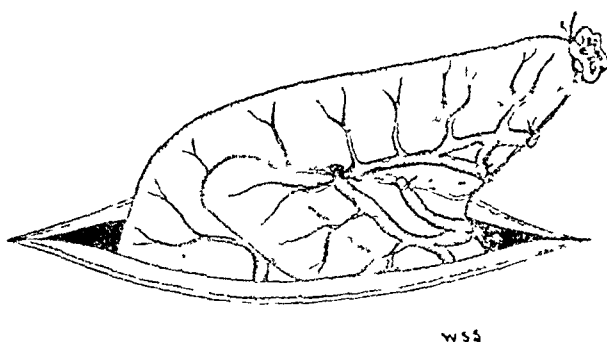
Three days later the protruding gut was cut away—a proceeding which was accompanied by free arterial bleeding, thus testifying to the good condition of this portion of the gut. Later in the same day a rubber tube was inserted—one end in the biliary fistula and the other in the subcutaneous segment of intestine—being safe-guarded from passing entirely into one or the other of the passages by an attached thread. The following day the patient passed a bile-stained stool. Six days later—nine days in all after the operation—the rubber tube was removed, and the edges of the fistula freshened and undermined for a short distance and then brought together. Three days later this last wound reopened and discharged *bile* and *faeces*.

This discharge continuing and remaining unchanged in character, it became plain that the attempt was a failure and that the fecal fistula must be closed. Accordingly, 26 days after the operation the patient was again taken to the operating room, the subcutaneous limb of gut exposed and freed. It was found only lightly adherent with its peritoneal coat preserved and glistening, though that portion of the mesentery which supplied it was more firmly united to the surrounding tissues. This portion of the intestine was removed close to the anastomosis and the open end closed and inverted. Palpation through the wound showed the tumor of the head of the pancreas markedly larger than before and gave indication that the biliary fistula consisted of the gall-bladder itself and not of the track of the choledochus drain as there had been some reason to suspect. This latter was confirmed by exposure of the fistula for a short distance. The gall-bladder was found to be shrunken, much thickened and firmly adherent to the neighboring structures on all sides. With great difficulty it was freed as far as the cystic duct. The second portion of the duodenum was mobilized by separation from the posterior abdominal wall along its right margin and the trimmed opening of the gall-bladder united with this by means of a Murphy button, supported by some reinforcing sutures. Closure of the abdomen



Method of dividing mesentery of loop of ileum (After sketch by Dr. Binnie)

FIG. 2.



End-to-side anastomosis of proximal into distal segment of divided gut (After sketch by Dr. Binnie)

FIG. 3

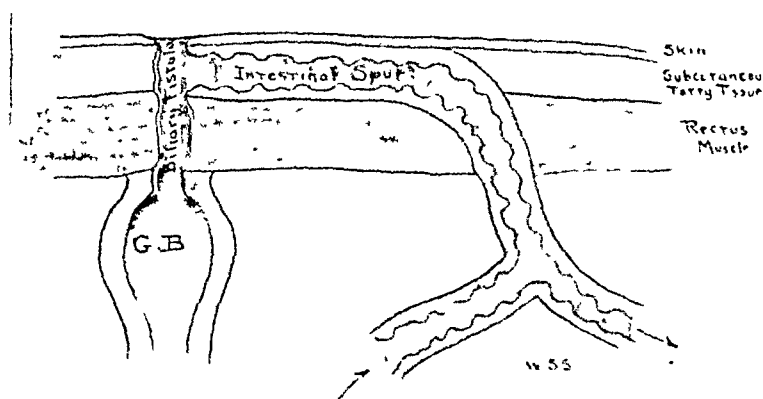


Diagram of relations of gut, fistula and gall bladder as established by operation of V. St. John (After sketch by Dr. Binnie)



was made with drainage to the site of the anastomosis. There was little drainage and the tube was removed on the third day. The patient improved in color and strength and even gained weight. The button was passed on the thirty-seventh day after operation.

This result shows that while the proposed operation of V. Stubenrauch is perfectly feasible as a problem in human architecture, it is a failure on physiological grounds. The diverted segment of gut in some cases at least will fail to exhibit sufficient peristaltic activity to prevent the back-flow through it of intestinal contents. Whether this is due to the absence of the impulse to contraction normally imparted to each segment by the one immediately above it in the act of peristaltic contraction, to the fact that any narrowing of the lumen in the subcutaneous portion of the gut is resisted by the adhesions to the surrounding tissue, to interference with the sympathetic nerve supply coming through the mesentery, or to a combination of all these factors, we must leave it to the experimental physiologist to determine.

PERMANENT COLOSTOMY.*

AN IMPROVED ORIGINAL OPERATIVE METHOD.

BY HOWARD LILIENTHAL, M.D.,

OF NEW YORK,

Attending Surgeon to Mount Sinai and Bellevue Hospitals.

THE formation of an artificial anus for the permanent relief of obstruction of the lower bowel is regarded by most surgeons as a loathsome makeshift for the prolongation of life. The mental picture of such an opening suggests the constant uncontrollable discharge of fæces and flatus, the painful and annoying dermatitis in the neighborhood of the exposed mucosa and the necessity for constant change of dressings—in short, a condition of actual and permanent disability for the ordinary duties and pleasures of life. Various forms of apparatus—valves, obturators, etc., have been devised for holding the discharges in check, all more or less uncomfortable to the patient and all inefficient in action.

For at least eight years I have been performing an operation which obviates nearly all the discomfort and filthiness of colostomy. The patients have absolute control of the bowels and can even hold a considerable quantity of fluid injected into the colon. The bowels move once or twice a day, the patient knows when the movements are about to occur and—not by any means the least advantage—he is not annoyed by the necessity for wearing an appliance for obturation. The operation has been tested many times and the patients have been for the most part carefully followed up. A description of the steps of the operation follow:

An incision about $3\frac{1}{2}$ inches long, more or less, is made over the outer third of the left rectus muscle and parallel with its fibres. The upper end of this incision is just about on a

* Read before the Section on Surgery of the New York Academy of Medicine, April 1, 1910.

line between the umbilicus and the left anterior superior iliac spine, but the exact length and location of the wound depends somewhat on the amount of subcutaneous fat present. Through this incision the fingers explore the abdominal organs and the type and limitations of the stricture or tumor are learned. The sigmoid flexure, be it well developed or not, is drawn out. As is well known, this part of the intestine varies greatly in length, but all is taken out which can be withdrawn without tension. The two legs of the loop are separated as widely as possible, the upper leg being sutured to the peritoneum and posterior rectus sheath in the upper angle of the wound, and the lower is sutured in a similar manner to the inferior angle. Silk or linen thread is the suture material, and the stitching is done by the continuous method, every third stitch being tied so as to avoid purse-stringing. The mesosigmoid is now sutured through and through to the peritoneum on each side (Fig. 1).

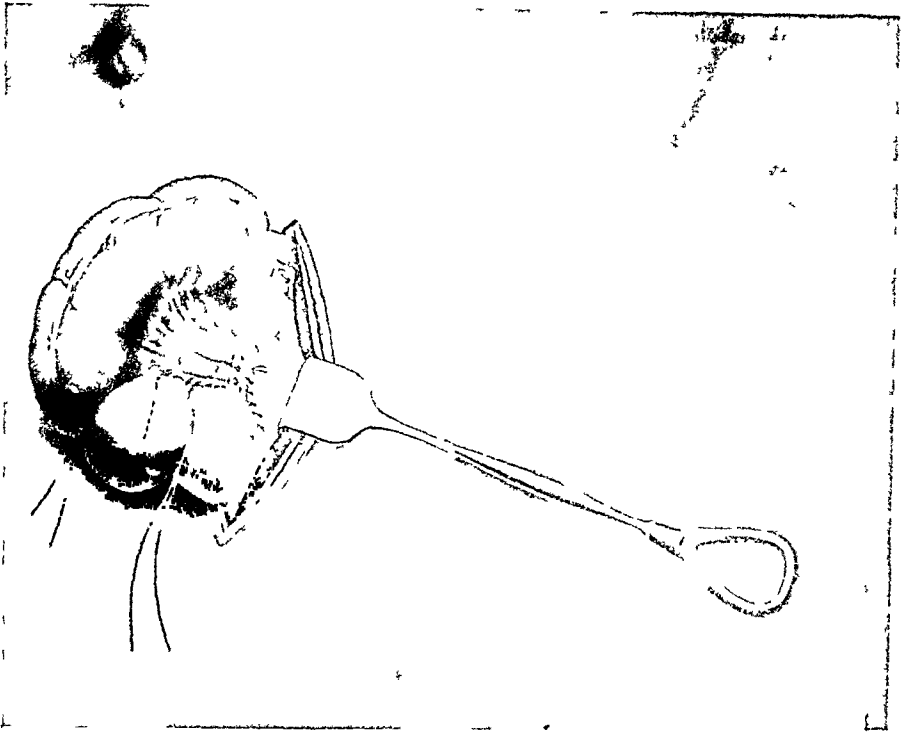
At the lower leg of the loop the gut is doubly ligated very tightly with heavy silk or cotton twine. Section is carefully made between the ligatures, taking care to avoid soiling from the small amount of imprisoned intestinal contents. Pure carbolic acid on a gauze sponge is used to sterilize the mucosa. Chain ligatures of catgut or silk are now passed through the mesosigmoid so as to prevent hemorrhage, and this membrane is then cut across. We now have a short piece of sigmoid, the distal leg of the loop in the lower angle of the wound and a long piece sutured in the upper angle of the wound. The remainder of the mesosigmoid is cut away from the long piece of intestine, freeing it completely. The entire wound is now protected by gauze packings, the peritoneum by our previous procedures being entirely closed off by suture. We should have about 3 or 4 inches of free sigmoid at the upper angle of the wound. If there is more it should be ablated. Four equidistant clamps are now placed at the edge of this upper piece of intestine, the gloved finger is inserted into the lumen of the gut to the place where it is held to the peritoneum by suture; an assistant rotates the clamps so as to twist the gut

around its longitudinal axis, after the manner described by Gersuny, from 180 to 360 degrees according to the texture and thickness of the walls of the sigmoid with which we are working. By withdrawing and reinserting the finger from time to time the degree of constriction which this manœuvre produces may be accurately gauged. When this seems to be sufficient for the purpose—a matter of individual judgment—a few interrupted silk or linen sutures passed through the visceral peritoneum and submucosa to the aponeurosis of the external oblique, hold the rotated gut in position. It is now necessary to make sure by re-examination that a sufficient twist has been accomplished. If this seems satisfactory more sutures should be put in to hold the gut firmly to the aponeurosis.

In examining with the finger now we find a double sphincter, the first one at the twist, the second, more an angulation than a sphincter, at the point of peritoneal fixation. A few chromic gut sutures close the portion of the remaining wound in the aponeurosis. The sphincteric action is maintained by the fibres of the rectus muscle as well as by the twist in the intestine. A large sized, rather stiff-walled rubber rectal tube, not a woven one, is now inserted about 6 inches into the intestine and is tied in place, a single light suture passing through its walls guarding against its accidental extrusion. The remainder of the wound is left open and packed with gauze while the tube is led off into a receptacle at the side of the bed. These wounds always become more or less infected, but I have encountered a true phlegmon only once and then a single incision sufficed for its drainage.

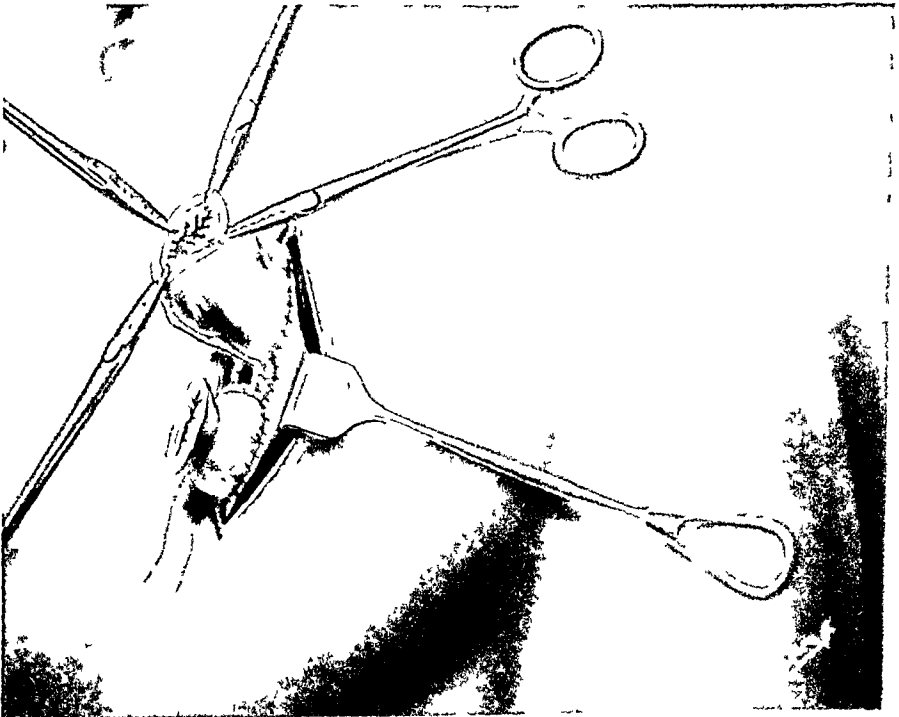
About a week after the operation the tube may be withdrawn and the redundant sigmoid burned off with the actual cautery. Anæsthesia is not necessary. Even then it will be found that repeated cauterizations will be required during the course of the healing in order to bring the intestinal mucosa to the skin level. Daily irrigations through the tube should be practiced so as to keep the patient's bowels open. The string around the lower piece of intestine should be

FIG. 1



The dotted line shows line of section. The blunt retractor is over right of rectus muscle together with skin and upon rest.

FIG. 2



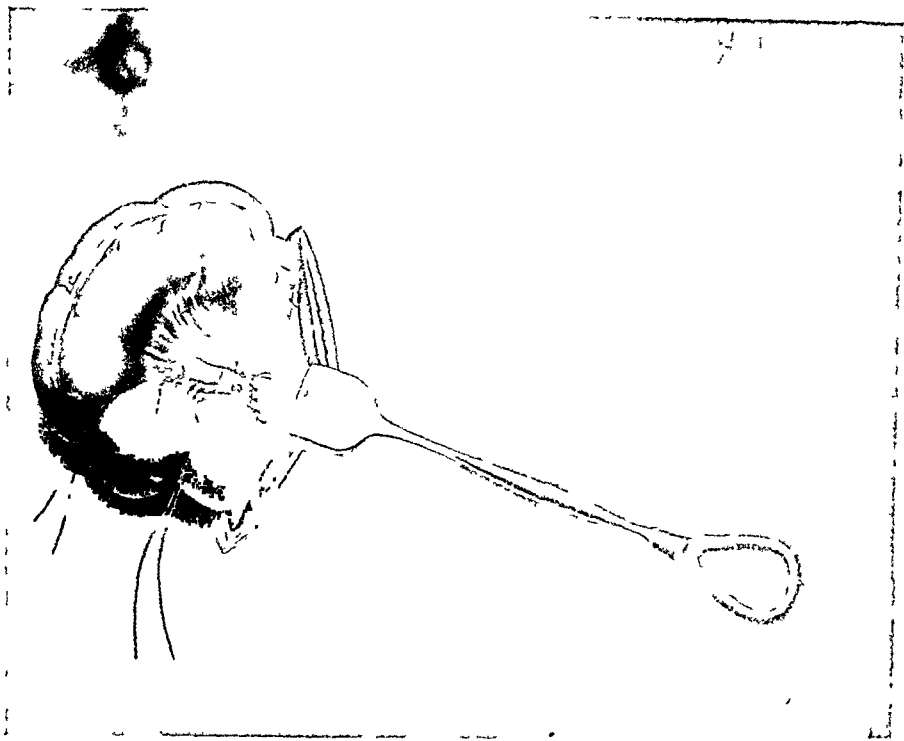
Redundant bowel and mesocolon cut away. Tying of the artery.

around its longitudinal axis, after the manner described by Gersuny, from 180 to 360 degrees according to the texture and thickness of the walls of the sigmoid with which we are working. By withdrawing and reinserting the finger from time to time the degree of constriction which this manœuvre produces may be accurately gauged. When this seems to be sufficient for the purpose—a matter of individual judgment—a few interrupted silk or linen sutures passed through the visceral peritoneum and submucosa to the aponeurosis of the external oblique, hold the rotated gut in position. It is now necessary to make sure by re-examination that a sufficient twist has been accomplished. If this seems satisfactory more sutures should be put in to hold the gut firmly to the aponeurosis.

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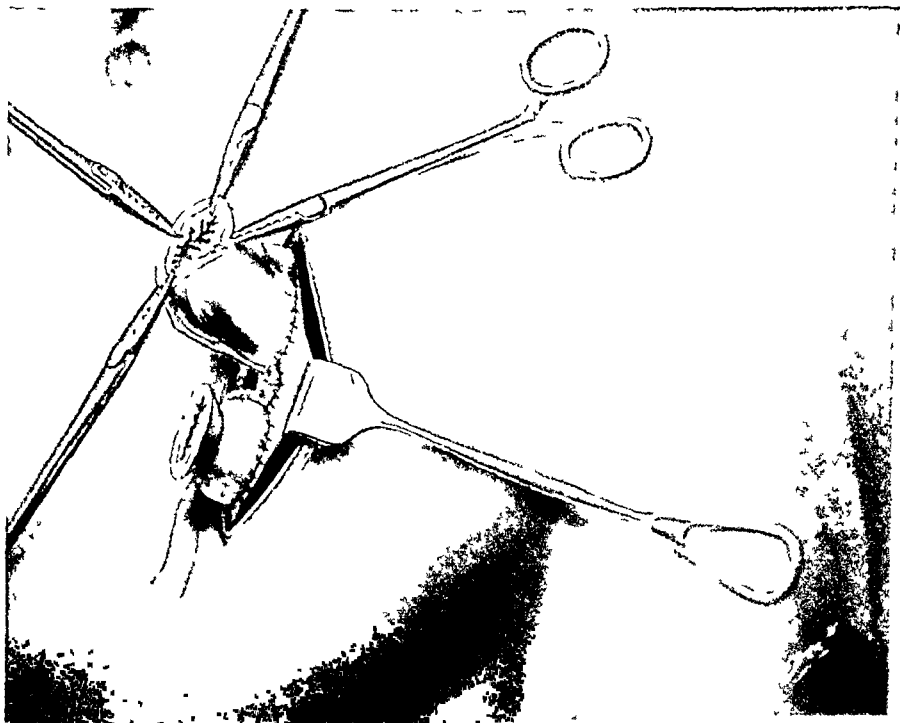
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FIG. 1

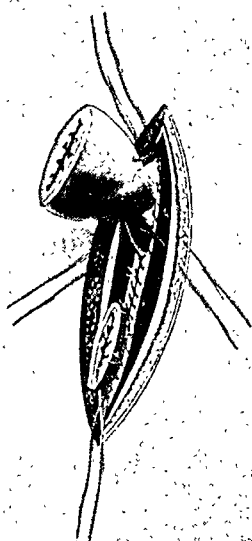


The dotted line shows line of section. The blunt retractor holds out center of rectum muscle together with skin and apicalosis.

FIG. 2



Redundant bowel and mesocolon cut away. Two strings of silk are used to hold mass.



Twist complete and maintained in position by anchor sutures holding sigmoid to aponeurosis.

FIG. 4.



Operation complete. Aponeurosis further stitched to intestine and wound closed with the exception of the skin.

removed in three or four days, otherwise there might be danger of complete and permanent closure and it is necessary to maintain patency here for the sake of drainage.

The control of the bowels is learned gradually by the patient, and he is assisted by a constipating diet and, for the first few weeks, small doses of deodorized tincture of opium and of subgallate of bismuth, 20 grains 3 to 5 times a day. It takes about a month for the final result to be attained, but the functional result in all uncomplicated cases will be found perfect.

MYELOMA OF THE LONG BONES.*

BY FRANK S. MATHEWS, M.D.,
OF NEW YORK.

UNTIL recently a list of the benign tumors of the body would have shown one derived from each of its tissues except marrow. Some writers now include "myeloma" in the list, but its significance is variable. This is not remarkable when we remember that this form of tumor is just being differentiated from the sarcomata and that the marrow itself is a complex structure. However, its cells may be divided into two categories: First, those concerned with osteogenesis, such as reticular stroma cells, some of which become fat cells and giant cells known as osteoclasts. Second, the cells lying in the meshes of the former and engaged in blood manufacture, such as myeloblasts, lymphocytes, erythrocytes, and others.

According to Adami, "not only may there be overgrowth of one or other of these orders, but even overgrowth of one particular form." Hence we need not be surprised in the future to learn of several varieties of bone-marrow tumors.

Before recounting the cases forming the basis of this paper, we may remark that none of them belong to the group of tumors to which the term "myeloma" is most often applied. The myeloma referred to is characterized as follows: It is composed of large round or polyhedral cells; it originates in the marrow of vertebræ, ribs and cranium, is a tumor of advanced life, is always multiple and Bence-Jones albumose is found in the urine. X-ray evidence will show that there are multiple tumors, and the detection of albumose in the urine clinches the diagnosis. Adami says this tumor has been recognized for many years under a variety of names. It is uncommon and never forms metastases.

During the writer's connection with St. Mary's Hospital for Children, he has seen clinically or has examined in the

* Read before the New York Surgical Society, April 12, 1910.

laboratory of the hospital five cases of tumor of the long bones, the pathological and clinical details of which follow.

CASE I.—Female, age 40 (patient of Dr. Charles T. Poore, who disarticulated at the knee joint for a central tumor of the upper end of the tibia). Fig. 1 is a recently made skiagram of the bone. The specimen had been split in its long axis. The tumor has originated at the end of the diaphysis, has destroyed bone and exhibited a marked pulsation over the inner tuberosity. The patient has remained well 19 years.

CASE II.—Female, age 28, patient of Dr. Charles N. Dowd, who disarticulated at the knee joint for central tumor of the upper end of the tibia. Fig. 2 is a microphotograph of the tumor which had practically destroyed the upper end of the bone. She was well when last heard from, four years after operation.

In both of these cases the tumor had expanded the bone and had reached such size as to be in contact with periosteum and joint cartilage, though in neither case had these structures been transgressed. Both cases are well, though the point of amputation was no great distance from the disease.

These two tumors in their histology are very similar; they are what is usually called giant-celled medullary sarcoma. The microscopic picture of one of these tumors is very striking. First there is the very cellular spindle-celled stroma; second, a very free vascular supply; and third, the giant cells. They are not called "giant celled" because of an occasional giant cell, as might be the case in a great variety of tumors, but because in these tumors giant cells are of such size and number as to constitute their most conspicuous feature. One may often count a hundred in a microscopic field and one giant cell may have a hundred clearly defined nuclei.

Normal bone marrow contains giant cells known as osteoclasts, some of which have a large, single lobulated nucleus, others many separate nuclei, still others a nucleus like a hollow sphere with holes in it. The osteoclasts, beside being normally found in the marrow, are found under pathological conditions following the course of vessels through the Haversian canals and appearing under the periosteum, where they may be conspicuous in such tumors as the giant-celled epulis of maxilla and mandible.

It is rather attractive to think of the giant cells of a myeloma as

inheriting their characters, though less diversified, from the osteoclasts of bone. On the other hand we may think of the osteoclasts, giant cells of myeloma and epulis, as nothing more than foreign-body giant cells developed in marrow, tumor or periosteum from the adventitia of blood-vessels whenever needed for the removal of foreign particles. Against this may be urged that they are very abundant in the myelomas and rather conspicuously absent in the sarcomas of bone or other tissues.

How shall we classify these tumors? Ribbert,² who recognizes but one variety of myeloma (the kind previously described), calls them sarcomata, but says of them: "Barring the local destructive process, the giant-celled sarcomata belong to the less malignant tumors. They grow slowly, are usually extirpated from the bone with good result, even occasionally recede and have little tendency to metastasis."

Sutton calls them myelomata and says they neither infect lymph-nodes nor disseminate.

Adami in his chapter on Sarcoma has omitted giant-celled sarcoma and in a foot-note states that this tumor has been taken from the sarcoma group. It finds a place in the chapter on Myeloma, and of it he says: "It grows locally most often in the shaft (marrow) of long bones or in the jaw; it may also be periosteal, as in the giant-celled epulis of the jaw; its growth is expansile, leading to the absorption of the surrounding bone; it does not form metastases, save in the infrequent cases in which it undergoes sarcomatous modification; it does not recur on complete removal, and, as recently shown, it is only necessary to remove the portion immediately involved with a very small surrounding zone."

CASE III.—H. McG., age 13. Admitted to St. Mary's Hospital for Children, August 27, 1903; discharged October 7, 1903. The boy had had tenderness about the middle of the shaft of the tibia for two months but there had been no severe pain. There had been no inflammation or trauma. In the middle of the tibial shaft there was a fusiform swelling four inches in length. Close to the anterior border of the bone one could feel through the skin covering the inner surface of the shaft a hole about the size of a lead-pencil. A small bluish area resembling a hæmatoma had formed about the spot where the bone had perforated.

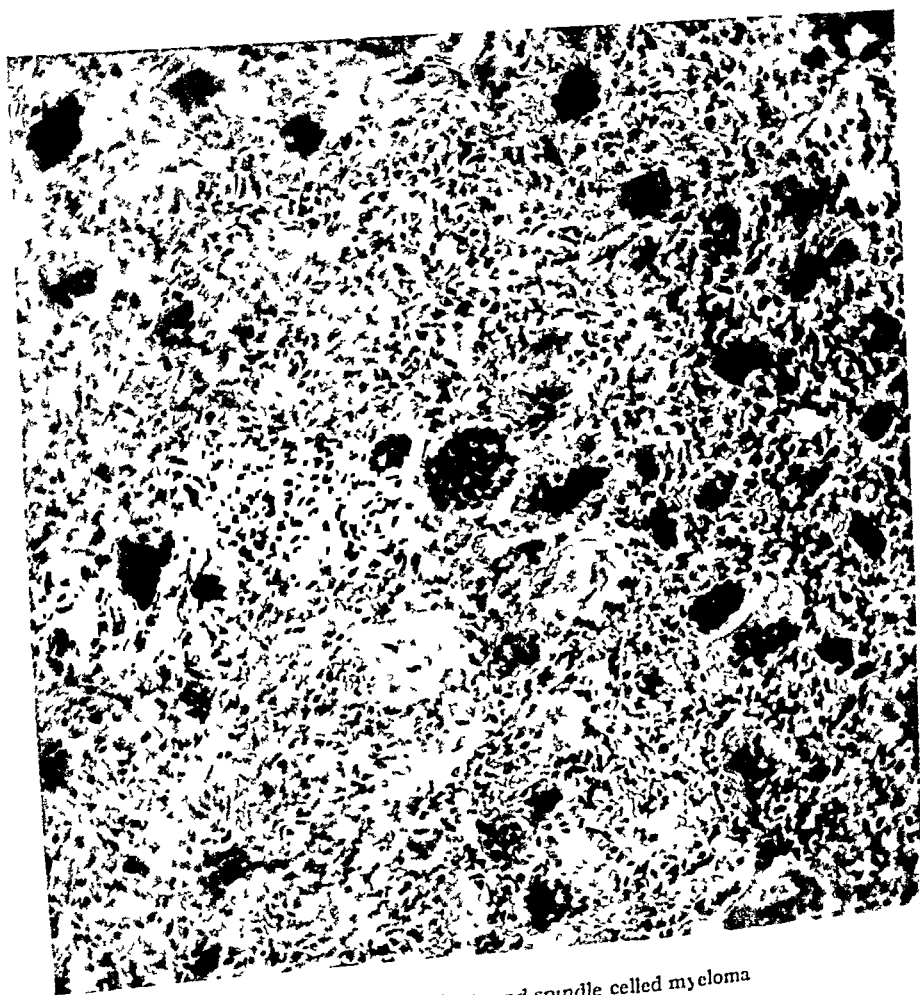
Operation.—Under ether the writer made a four-inch incision

FIG. 1.



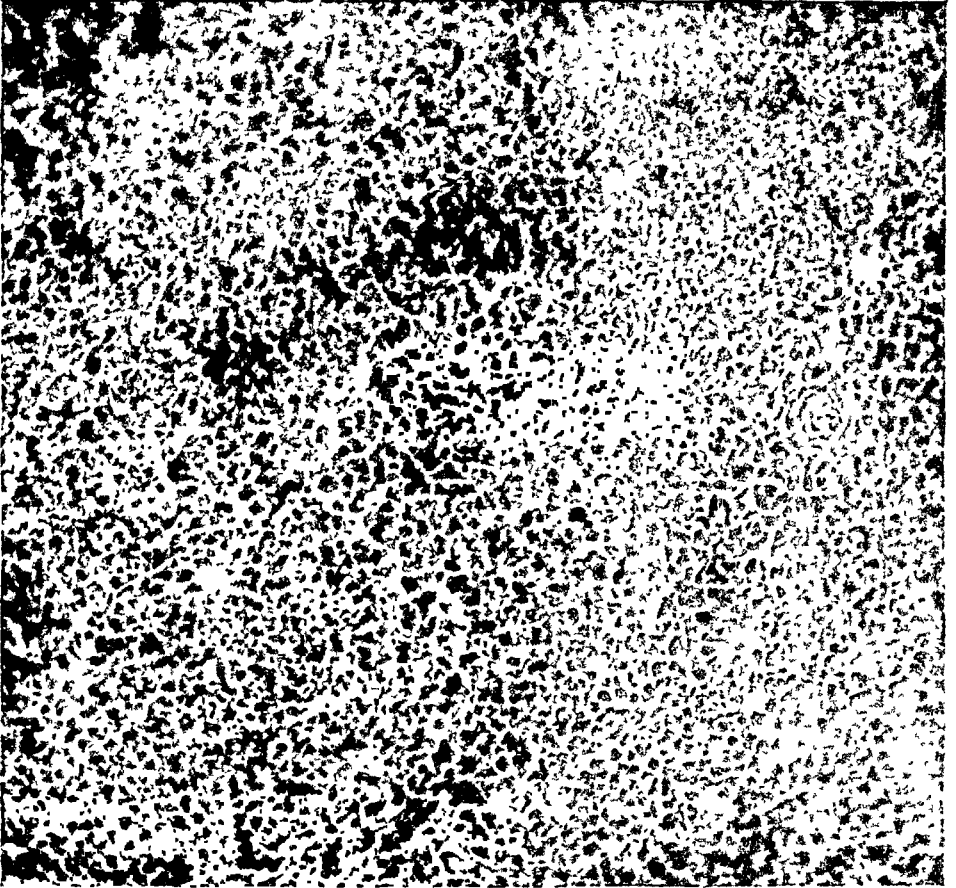
Case 1. Myeloma of upper end of diaphysis of tibia

FIG. 2.



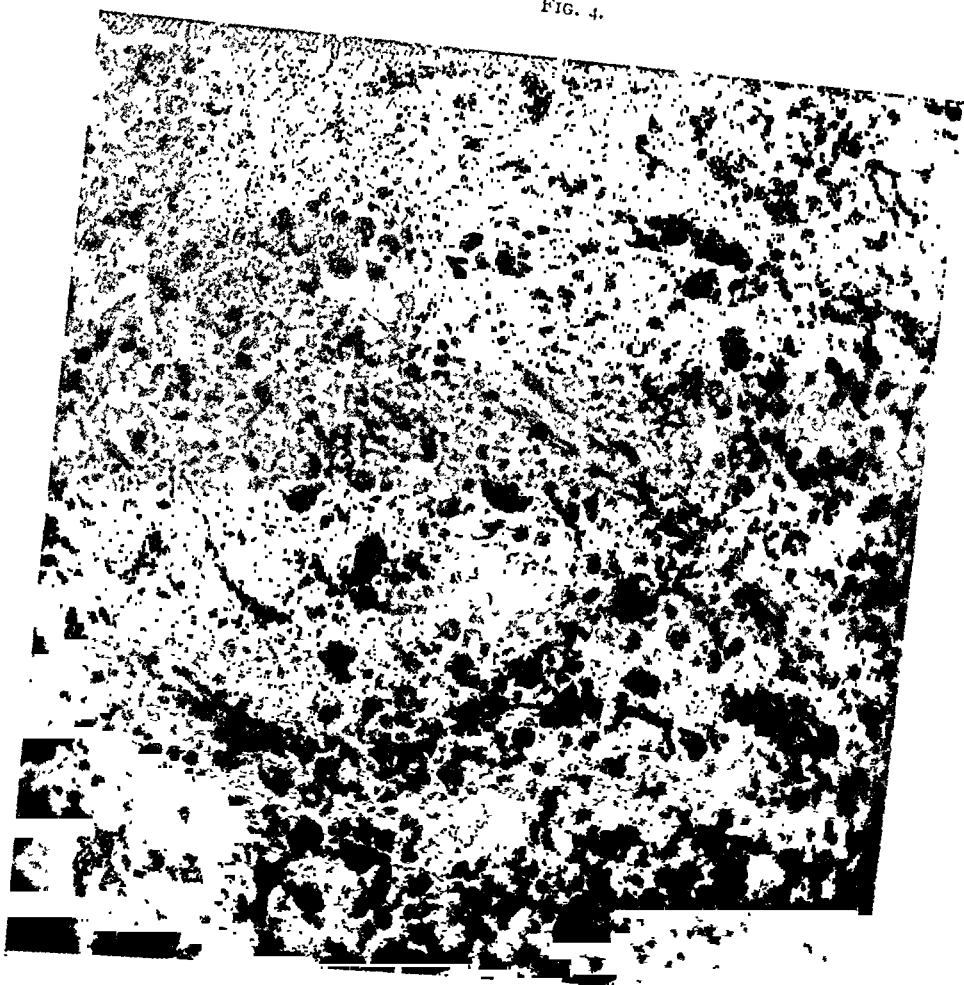
Case II. Typical giant- and spindle celled myeloma

FIG. 3.



Case III. Round- and polyhedral-celled myeloma.

FIG. 4.



Case III. Small area showing perivascular giant cells

FIG 5.

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Case IV. Myeloma of femur.

FIG 6.



Case V. Osteosarcoma of upper end of tibia.

down through the periosteum which was peeled back and the perforation enlarged until the medullary cavity was opened for about four inches. The medulla was replaced by a red vascular tissue which had perforated the cortical bone at one point. The tumor tissue was removed with a curette. The edges of the gutter thus formed were cut down so that the periosteum could be folded over into the cavity of the shaft as in the Neuber operation. The skin wound was closed and recovery was uneventful. No recurrence has appeared in seven years.

Histology.—The tumor, as might be inferred from its method of removal, is in small pieces and in many areas infiltrated with blood. The tissue is channelled by many thin-walled blood-vessels, and occupying the intermediate spaces is the tumor mass proper made up of large polyhedral cells with fair sized deeply staining nuclei and abundant cytoplasm (Fig. 3). In places the cells contain a reddish brown pigment, probably blood pigment. There are also giant cells, but none of large size. In large areas of the tumor they are entirely absent. In spots they show a tendency to group themselves about blood-vessels or tissue spaces, as illustrated in Fig. 4.

Here we have a tumor rather different in its histology from the two former and one's impression would be that it was more likely to prove malignant. Such, however, cannot be the case, since the tumor had already perforated the bone, since the operation was only a curetting and the growth has not recurred in seven years. I believe the histological and clinical discrepancy to be only apparent. The tumors of the giant-celled variety previously described probably originate in the osteogenetic elements of marrow, and were a tumor of such origin of a distinctly round-celled type it would probably be malignant. But in this case the tumor probably owes its origin to the marrow cells (myelocytes) which are in their normal adult form round cells.

We are not dealing with cells which have widely departed from the normal, hence malignant, but to quote Adami once more, "with cells which when at their fullest development are of relatively simple type."

CASE IV.—P. S., girl, age 5 years. Operated on at St. Mary's Hospital June, 1904, for knock-knees, by supracondylar osteotomy of the femora. Readmitted to hospital May 17, 1909,—age 10

years,—suffering from a tumor of the lower end of femur in the shaft proximal to the epiphysis, as is shown by X-ray.

The story was that a lump had appeared within a few months of the knock-knee operation and had grown steadily. A skiagram was taken and amputation recommended but refused. This tumor then by X-ray (Fig. 5) shows the characters of the giant-celled myeloma; it had existed nearly five years, had not impaired the patient's general health and had apparently not formed metastases.

The writer saw this patient again on March 7, 1910, nearly six years after the knock-knee operation. In the past nine months the tumor has increased considerably in size. The patient puts very little weight upon the limb. Bone has disappeared in spots and in others there are thin plates. The circumference of the thigh is 18 inches. The child is undersized but not ill-nourished, and abdominal and chest examination is negative. She gets about by using a crutch. Pathological fracture has not occurred.

CASE V.—A. D., age 14. Admitted October 6, 1902. This child also had a growth at the upper end of the tibia. Amputation was done by Dr. Dowd above the middle of the thigh. She was removed from the hospital on January 28, 1903, with the wound unhealed, the disease progressing in the stump and presumably disseminating, as she left the hospital in very poor condition. This case contrasts in many ways with those above mentioned. The disease was given a wider berth at operation, but three months later was progressing to a fatal termination.

This growth would be classed as a spindle-celled periosteal sarcoma. Reference to the skiagram of the bone, Fig. 6, shows that the growth was actively engaged in bone formation, an osteosarcoma as distinguished from the myelomas which are destructive of bone. Sections from parts of the hard tumor showed all of the different stages seen in the development of normal bone in cartilage. There can be seen hyaline cartilage, absorption of the cartilaginous matrix, calcified cartilage and fairly typical new bone. As soon, though, as one leaves the original growth attached to the tibia and examines detached tumor masses—say in the skin—one finds

none of the tissues mentioned, but only a typical large spindle-celled sarcoma.*

The papers of Nancrède⁸ and Coley,⁴ which have appeared within a year, warn us of the terrible malignancy of bone sarcoma. Sutton tells us of a case of his that ran its course within three months, the patient being suffocated by intrathoracic calcified metastases. As these very malignant tumors of the periosteum often invade the bone and marrow, it is not unlikely that at times they have been mistaken for medullary growths and hence a malignancy attributed to medullary tumors, which they do not deserve. Rotch⁶ shows a very good skiagram of a periosteal sarcoma invading the bone.

The myeloma here considered then is a tumor resembling the red marrow of young bone characterized by great vascularity, by giant cells and spindle to round or polyhedral cell structure. It is benign. Nearly all writers agree that it does not form metastases. It is admitted that it might undergo a sarcomatous transformation just as a myoma of the uterus might. Bloodgood, who calls them sarcomata, says he has investigated 100 such cases without having found one authentic case of dissemination.

We may say that it possesses a malignancy of the second order,—that is, from its local destructiveness,—hence leading to the sacrifice of limbs. Clinically it selects most often the upper end of the tibia, less frequently the lower end of the radius. Then comes the femur, mandible, humerus, ulna, and clavicle in a series of diminishing frequency.

The patients are usually under twenty-five years of age. There was a history of trauma in but one of our cases. The growths are described as "expansile," which means that bone is destroyed by the tumor, while new bone is being deposited by the periosteum. When the tumor reaches the periosteum

* It has been maintained by some that in cases like this the sarcoma does not form specialized tissues like cartilage and bone; that the sarcoma is destructive only, and that its presence stimulates normal cells of the periosteum to form these tissues, i.e., that the sarcoma cells and bone-forming cells are different, simply intimately associated in the mixed growth. In this tumor one can see almost every gradation from spindle-celled sarcoma to normal bone.

we find thin scales of bone being formed which give the egg-shell crackling. The vascularity of the tumor and the disappearance of bone give rise finally to a pulsatile growth and the impression of "bone aneurism." While a myeloma destroys bone, spicules of bone often penetrate the tumor from the surface after the manner of the new bone in subperiosteal hæmatoma. This may delay spontaneous fracture.

A number of writers say these tumors may occasionally retrogress. One case described by Coley⁷ would seem to be of this kind. Two inches of the lower end of the radius had been resected by Hibbs. Two years later the cavity was occupied by a soft mass of tissue and the wound had refused to heal. Bull, Curtis and Coley recommended amputation, which was refused, and the patient recovered without other treatment and was well six years from the date of resection of the radius.

Diagnosis.—In the early days of such growths the X-ray picture will aid greatly. These growths usually originate in the diaphysis of the long bones adjacent to the epiphysis. This is well shown in Fig. 5 and less well in Fig. 1. Rotch⁶ shows a skiagram well illustrating this origin. Even when the disease is advanced and the epiphysis involved they do not perforate the joint cartilage. They may stretch the periosteum without invading or destroying it for years, as in Case IV. If we diagnose a tumor of marrow by X-ray or otherwise, we are fairly safe in assuming it to be a myeloma. Sutton says, "I am inclined to think that round- or spindle-celled central sarcomata of the tibia are rare tumors."

Assuming then that we are dealing with a myeloma, it may be the multiple myeloma already mentioned. This will probably occur in the aged, and skiagrams of a number of bones will show multiple tumors. Those chiefly affected are the cranial bones, vertebræ, sternum and ribs. Albumose is found in the urine. On the other hand, the giant-celled variety will affect the extremities and mandible—most often the tibia. The patient will be young and the tumor single.

Treatment.—The writer has been interested in reading for the last ten years Bloodgood's articles on bone tumors in

Progressive Medicine. Much credit is due to him for urging the conservative treatment of the myelomas. He calls them giant-celled sarcomas, but says he has never heard of one disseminating, that he has personal records of 16 cases of such tumors of the long bones and that all are alive and well. This is indeed very unlike the behavior of sarcoma, certainly of bone sarcoma. So long, however, as these tumors retain the name sarcoma we may expect the average surgeon to accord them the usual treatment of sarcoma, namely: the widest possible removal. Since nothing worse than a local recurrence is to be feared after operation on the myelomas, and since medullary round- or spindle-celled sarcoma is so exceedingly rare, we are justified in palliative operation and even exploratory incisions and final resort to microscopic diagnosis.

If the diagnosis of myeloma is reasonably sure we may curette the disease in cases where a bone shell can be left behind. In other cases a subperiosteal resection may be employed. In the lower end of the radius this procedure has the advantage over the ordinary resection, that the ulna does not have to be resected too, as would be the case when the periosteum of the radius is sacrificed. In the case of the upper end of the tibia, amputation has been the rule, but some cases have been curetted, leaving a large cavity which has required a year or two for healing and filling with new bone.

Tumors in which the periosteum has been reached and stretched out by the growth may still be curetted, with the possibility that repeated curettings may finally bring a cure, as has been the result in some cases, or the attempts to preserve the limb may fail and amputation be finally required. Sutton speaks as though amputation were necessary when the femur is involved; but though without experience in such cases, I see no reason why in an early tumor where the epiphysis is uninvolved a resection of part of the bone or a subperiosteal resection should not be tried in the former case, expecting a short limb. Our Case IV would seem too extensive for such treatment, and conservatism would seem only to suggest the preservation of a stump of the femur to permit of

the use of an artificial limb. It is to be remembered that some cases have retrogressed after an operation which was deemed incomplete.

The skiagrams presented were made by Dr. Louis Gregory Cole, the microphotographs by Dr. Edward Leaming. I am indebted to Drs. Poore and Dowd for the privilege of using their cases.

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- ⁶ Rotch: Röntgen Rays in Pediatrics, 1910.
- ⁷ Coley: Sarcoma of the Long Bones, ANNALS OF SURGERY, March, 1907.
- ⁸ De Nancrède: End Results After Total Excision of the Scapula for Sarcoma, ANNALS OF SURGERY, July, 1909.
- ⁹ Trotter: Diagnosis of Common Swellings of the Long Bones, The Clinical Journal, London, 1907.

ADDENDUM.—After the above had been put in type the writer discovered the very thoughtful paper of Wilfred Trotter and inserts a few quotations from it bearing on our topic.

"The myeloid tumor is by far the most common and produces a characteristic and stable clinical type. As is well-known, all varieties of sarcoma of bone are apt to contain giant cells. Except in the myeloid these cells are relatively small, do not contain more than three or four nuclei and occur in small numbers. In microscopic diagnosis of a myeloid it is necessary therefore to establish that the tumor contains large numbers (several in a low power field) of giant cells of a special type. These, the true myeloid cells, are very large and contain a dozen or more of nuclei massed in the centre of the cell. Unless such a definition of a myeloid sarcoma be accepted, avoidable errors in prognosis are likely to be made."

* * * "It causes a globular enlargement of the ends of bones and the enlargement ceases abruptly with the limits of the tumor. Spontaneous fracture is rare except in late cases. The articular cartilages and to a less extent the epiphyseal cartilages show a marked resistance to the advance of the tumor so that the actual epiphysis may escape expansion."

* * * "If a swelling which by its firmness and well-defined outline suggests a tumor and by its involving the whole circumference, a central tumor, shows a bossy surface and an absence of globular limitation but rather a tendency to spread far along the shaft then it is not a myeloid but a central sarcoma of other structure."

As to periosteal sarcoma—"A section of a specimen will generally show that the growth has quite early penetrated the bone and extended along the medullary cavity. There is a greater tendency to fracture than with myeloid sarcomata."

TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY.

Stated Meeting, March 23, 1910.

The President, DR. ELLSWORTH ELIOT, JR., in the Chair.

OSTEOSARCOMA OF THE LOWER JAW TREATED BY PARTIAL OPERATION FOLLOWED BY MIXED TOXINS (Erysipelas and Bacillus Prodigiosus).

DR. WILLIAM B. COLEY presented a boy, seventeen years old, whose family history was good, and who gave no history of antecedent injury. When admitted to the General Memorial Hospital, January 10, 1910, he stated that he had always been in good health until the latter part of November, 1909, when he noticed an enlargement of his lower jaw, most marked in the region of the symphysis. The tumor grew very rapidly, extending on both sides, and soon involved the floor of the mouth. There was no pain at any time.

Examination showed a tumor, $4\frac{1}{2}$ by $2\frac{1}{2}$ inches in size, smooth and symmetrical, occupying the entire lower portion of the jaw and extending back nearly to the angle on either side. There was also a mass projecting downwards fully an inch beyond the normal outline of the bone. The mass in the floor of the mouth was continuous with the jaw, and filled up the space nearly to the level of the teeth. The skin over the chin was normal, and there was no evidence of ulceration in any part of the tumor. In consistence, the growth was very firm and hard, a typical osteosarcoma, causing marked deformity due to the elongation of the chin.

Inasmuch as the only operation that could be performed with any hope of success would have been removal of almost the entire lower jaw as far back as the angle, it seemed wiser to do a partial operation, to be immediately followed by the use of the mixed toxins. Therefore, on January 11, 1910, with the assis-

tance of Dr. William A. Downes, the following operation was done: The lower lip was drawn forcibly downwards, without cutting it. The mucous membrane on the inner side was then cut, exposing the outer portion of the tumor. The soft parts were separated from the tumor, and by means of a chisel the larger part of the external portion of the tumor was removed, a sufficient amount of alveolar process being left to hold the teeth firmly. The inner portion of the tumor, which was somewhat larger in size than an English walnut, and occupied the floor of the mouth, was not touched at all. Macroscopically, the tissues removed were typical of osteosarcoma.

A microscopical examination of the tissues was made by Dr. James Ewing, who reported it as a giant-celled osteosarcoma. It was not the ordinary encapsulated giant-celled sarcoma of the jaw or of the epulis type, but a tumor infiltrating in all directions, of rapid growth and with a large amount of new bone formation.

Two days after the operation the patient was put upon small doses of the mixed toxins, given in the pectoral region. These injections were continued about four times a week during his five weeks' stay in the hospital, 28 injections in all being given. Only three of these were made into the tumor on the floor of the mouth.

After the boy's return to his home in Poughkeepsie, where he was under the care of Drs. Sadler and Borst, the injections were continued three times a week, the highest dose being five minims. They produced a moderate reaction, with an occasional chill followed by a temperature of 103 or 104, but usually only by slight malaise and a temperature of 99 or 100.

After the first three or four injections there was noticed a marked diminution in the size of the growth that had been left behind, both externally and internally, and when he left the hospital, the tumor in the floor of the mouth had diminished to one-third of its original size. Since then, the remainder of the tumor had nearly disappeared. The tumor tissue which was necessarily left behind externally had also gradually become absorbed, and there was absolutely no deformity remaining.

FIBROSARCOMA OF THE UPPER JAW.

DR. COLEY presented a man, twenty-five years old, whose family history was good, and who gave no history of trauma. Three months before the patient first noticed a swelling of the upper

jaw, left side. This tumor gradually increased in size, causing partial obstruction of the left nostril.

Operation, February —, 1910, Dr. Downes assisting. An incision was made through the mucous membrane just over the alveolar process, and through an opening into the antrum about the size of a small English walnut the tumor was removed by gouge and curette. The tumor was not encapsulated; the cells were moderately infiltrated.

Dr. Coley said that in view of his success with the previous case of osteosarcoma of the lower jaw, it seemed advisable to try the mixed toxins in this case also before resorting to such an extensive operation as complete removal of the upper jaw. Accordingly, four days after the operation, the patient was put upon the toxins, which were repeated four or five times a week. All of the injections were systemic, being given in the pectoral region. At the end of about two weeks, the remaining portion of the swelling had gradually subsided, and although it was still apparent, it was steadily decreasing in size. Should there be any evidence of an increase, an immediate radical operation would be done.

SARCOMA OF THE OMENTUM.

DR. ELLSWORTH ELIOT, JR., presented a woman forty-six years old, who was admitted to the Presbyterian Hospital in November, 1908, with a large uterine fibroid for which a supravaginal hysterectomy was done, removing the tumor, together with the left tube and ovary and the right tube. The pathological report was "fibroma of the uterus." There were several large tumors, one of which showed central degeneration. The patient left the hospital cured.

She was re-admitted in July, 1909, complaining of a feeling of abdominal distention and weight, with increasing distress. There was loss of appetite; the bowels were regular; no vomiting. Examination disclosed the presence of an intra-abdominal mass.

Operation, by Dr. George Woolsey.—Upon opening the abdomen a considerable amount of blood-tinged, non-odorous fluid escaped, and a tumor about the size of a large grape fruit came into view. It was smooth and shiny, and purplish red in color. It was freely movable, and attached broadly to about six inches of mesentery and ten or twelve inches of small intestine, with several other loops adherent. It was also attached to the omen-

tum by two pedicles. The adherent intestine was easily separated from the tumor, which was soft, elastic, friable and non-fluctuating. The mesentery was more firmly adherent, but after incision the peritoneum could be stripped off with gauze, each bared place bleeding profusely. The pathologist reported that the growth was an encapsulated tumor composed of spindle cells with large nucleus-like cells of fibrous tissue; mitotic figures; rapid growth. Diagnosis, fibroma, much resembling spindle-celled sarcoma.

The patient again presented herself on February 28, 1910. She stated that in the latter part of November, 1909, while examining her abdomen, she found a tumor the size of a fist. She had had no other symptoms. The bowels were regular; no flatulence; no vomiting. Her weight had increased since her previous stay in the hospital. Examination showed a prominence of the abdomen on the right side and below the navel, where a mass was felt which extended from the level of the navel to the pelvic brim. It was firm and hard and freely movable, excepting that it seemed to be bound down posteriorly. It was rough to the feel, was not tender and no softened areas could be made out.

Operation, by Dr. Eliot.—On opening the abdomen a globular mass, about six inches in diameter, was exposed. Its surface was irregular, and showed large veins. It was adherent to loops of small intestine, to the ascending and transverse colon and to the omentum and mesentery, and contained a small amount of serosanguinous fluid. After separating the adhesions, the tumor was removed. The pathologist reported that it was a spindle-celled sarcoma.

Dr. Eliot said that while he understood that malignant degeneration of a fibroid tumor was not an infrequent or rare secondary condition, still this was the only instance that he could recall among the considerable number of fibroid tumors that had been seen and operated on at the Presbyterian Hospital during the past ten or fifteen years.

DR. GEORGE WOOLSEY said that the tumor removed by him from the patient shown by Dr. Eliot at that time had all the appearances of a malignant growth. What it grew from was a question, but it appeared to grow from the mesentery. It had some resemblance to a mesenteric cyst, but was more solid to the

feel. It was more adherent to the mesentery than to any other structure and the adhesions were very vascular.

A short time after operating on this case, Dr. Woolsey said, he had another case of a very rapidly growing tumor of a similar kind, but much larger and more vascular. It was three or four times as large as the one in the first case. In this second case the growth was a sarcoma. The patient died from shock.

DR. COLEY, discussing Dr. Eliot's case, said the change in the type of a tumor from fibroma to sarcoma was well illustrated in a case reported by the late Dr. A. J. McCosh, where a Princeton student, following an injury, developed a tumor which was pronounced a pure fibroma. It was removed, but recurred within a year, and at the second operation it was pronounced a fibroma with some spindle-celled sarcomatous elements. It recurred again, and then showed distinct type of spindle-cell sarcoma. At a still later recurrence it proved to be highly vascular, and at the time of the patient's death, instead of a spindle-celled sarcoma, it was almost of the pure round-celled variety.

Dr. Coley said he could recall two or three other cases where a similar malignant degeneration had taken place, and this emphasized the importance of giving heed to the clinical signs of malignancy even if not confirmed by the microscopical examination. In the case shown by Dr. Eliot, some of the infective cells were doubtless left behind, and a further recurrence was almost certain to occur. For that reason, it might be advisable to employ the mixed toxins as a prophylactic measure.

DR. FRANK S. MATHEWS said that the number of uterine fibroids that underwent sarcomatous transformation was probably very small. Of 1700 such cases observed by Cullen, only one per cent. showed sarcomatous changes. In a myoma œdema and various degenerative changes may simulate sarcoma. Most of the sarcomas of the uterus begin as sarcoma of the mucosa; occasionally one originates in the musculature independent of any myoma.

DR. ROBERT T. MORRIS said that in one case where he had removed a fibromyomatous uterus and left the cervix two years ago, a large tumor had recently developed rapidly from the cervix. He had removed this last week. Macroscopically, it was apparently carcinoma, but he had not yet received the pathological report.

VOLVULUS OF THE SMALL INTESTINE IN A CHILD.

DR. WILLIAM A. DOWNES presented a girl, nine years old, who was admitted to the New York Hospital, in the service of Dr. Frank Hartley, on November 21, 1909.

With the exception of measles, the child's past history was negative. Two days before admission she was taken with violent abdominal pain, cramp-like in character, and accompanied by vomiting. The bowels had moved about the time the pain began, but not since. The pain was general at the outset, but later became more marked at the umbilicus. At the time of admission, the child's temperature was 98.4; pulse, 160; respirations, 24. She was in a condition of extreme shock, with ashen color and cold extremities. The abdomen was retracted and fairly rigid, this being most marked in the umbilical region. A rectal examination showed an indefinite mass at about the level of the brim of the pelvis. No bloody mucus was passed. No blood count was made, as the child was taken immediately to the operating room.

Operation.—The abdomen was opened through an intermuscular incision, and upon incising the peritoneum, about a pint of bloody serum escaped. The appendix presented, and excepting for a small concretion, it was normal and was not removed. Upon passing the finger along the ileum, about a foot from the ileocaecal junction, the gut became deeply congested. The incision was then enlarged by splitting the sheath of the rectus, and fully one-half of the small intestine was found to be mahogany colored, with soggy walls. No definite twist of the mesentery could be made out. The vessels seemed palpable, but as no pulsation could be made out the condition was thought to be a mesenteric thrombosis. The peritoneum had not lost its lustre, nor did it break at any point during manipulation, but after waiting for ten minutes and wrapping it in salt compresses, the color did not improve.

The extent of the involvement and the general condition of the child, even though the vitality of the gut seemed extremely doubtful, made any attempt at excision out of the question. It was therefore decided to leave the entire mass outside of the abdominal cavity. Gutta-percha tissue was wrapped around the coils, and this was covered with gauze wet with salt solution. An infusion

of salt solution was given during the operation. At the completion of the operation, vomiting ceased almost immediately.

At the end of 24 hours the gauze dressing covering the intestines was changed. At this time, the color of the gut, seen through the gutta-percha dressing, was almost normal. At the end of 48 hours the dressing was done under ether, and the intestine was found to be absolutely viable. The mesenteric arteries were pulsating, and no trace of the former condition was visible. The fibrin was removed from the coils of intestine, which were then returned to the abdominal cavity, and the wound was closed with the exception of a small opening for drainage. The child's recovery was uneventful.

DR. COLEY said that in one case where he had removed four feet of the small intestine for a strangulation of the gut, the patient made a good recovery, but subsequently suffered from a very severe diarrhoea lasting a year. This condition was especially annoying after taking meat or solid food, while on a rice diet he got along fairly well.

DR. DOWNES said that in one case where he removed three feet of the small intestine, the stools were not affected.

INJECTION OF BLOOD FOR AN OLD UNUNITED FRACTURE OF THE TIBIA AND FIBULA; RESULT, BONY UNION.

DR. HENRY H. M. LYLE presented a man, forty-six years old, who sustained a compound fracture of both tibiae and fibulae. He was taken to a hospital where he was operated on September 30, 1908. The fragments were reduced, the ends of the bones trimmed and the splinters removed. Three and a half months later there were no signs of union. A second operation was done at which sections of the bones were removed and the ends freshened. This was also unsuccessful, and four months later there were no evidences of union. At a third operation an attempt was made to correct the position of the bones and freshen the ends. Orthopaedic braces were applied, and the ends of the bones stimulated under gas. This also proved unsuccessful.

A year after the original operation the patient was admitted to St. Luke's Hospital, in the service of Dr. Charles L. Gibson. Examination showed an ununited fracture of the right tibia and fibula, and weak fibrous union between fragments of the left tibia and fibula. Operative and orthopaedic measures having

failed, it was decided to try Bier's method of blood injection combined with passive hyperæmia. Accordingly, twenty c.c. of the patient's own blood was injected between the fragments. Four injections were given, and at the end of three weeks there was firm fibrous union. Three weeks later there was bony union and the leg was so strong that the patient could bear his weight upon it.

CHOLELITHIASIS, SIMULATING CARCINOMA.

DR. ELIOT presented a man, sixty-five years old, who was admitted to the Presbyterian Hospital on February 16, 1910. He had always enjoyed good health until about two months before admission, when he was exposed in a cold room for several hours. This was followed by a chill and an attack of vomiting. For two weeks he complained of constant chilliness, his appetite became poor and he had hot sweats after going to bed. He gradually lost strength. Two weeks later, after a second exposure, he was obliged to remain in bed three days with a severe cold "all over." Since that time he had complained of chilliness; he had lost 50 pounds in weight and much strength. He had a dull, continuous frontal headache and suffered from occasional sweats, usually at night. He thought he had become very pale.

Six weeks prior to the patient's admission he began to have attacks of vomiting, usually occurring about half an hour after eating, especially if he partook of meat. There was no nausea between the attacks of vomiting and no eructations of gas. The quantity of the vomitus was always small, and apparently consisted only of food particles. He was constipated. The stools were of the usual color, but small in amount.

Physical Examination.—The patient was moderately emaciated, with loose skin of a slight icteroid hue. The mucous membranes were somewhat pale. The patient looked cachectic. The breath was sour; the tongue heavily furred. The edge of the liver was an inch and three-quarters below the costal margin in the right midclavicular line; it could not be felt below the costal margin in the axillary line. It was thin and smooth, and felt as though it were being pushed forward from behind. On the edge, about two inches from the mid-line, there was an indefinite sense of resistance. There was no tenderness.

The urine showed no significant changes and contained no

bile before the operation. A gastric analysis gave a total acidity of .197 per cent.; free hydrochloric acid, .058 per cent., and a trace of lactic acid.

Operation.—This was exploratory in character. A median incision was made above the umbilicus, through which the stomach, gall-bladder and ducts, the duodenum, the pancreas, etc., were explored. As the gall-bladder was found to be enlarged, a second incision was made so that better access might be gained. Upon opening the gall-bladder, a stone, about the size of a large olive and very soft in consistence was found in the neck. The bile was turbid and brown. There were adhesions about the cystic duct and pylorus. No new growth was found. The calculus was removed, and a catheter sewed into the gall-bladder for drainage.

The patient made a good recovery from the operation. About twelve or fourteen ounces of bile, which soon became green and clear, drained into a bottle for the first few days, and on the fourth day the catheter was replaced by a rubber tissue drain. Since then the bile had flowed almost continuously from the wound, which had nearly healed. Since the operation, the patient had become brighter and had apparently gained some weight. The urine had persistently shown bile, and the stools were still clay colored, having been so since the operation. The patient was still in the hospital, but was allowed up in a chair and was slowly gaining.

Smears and cultures from the gall-bladder showed various kinds of bacteria, some resembling the colon bacillus.

This case, Dr. Eliot said, was of special interest because it seemed to show a chronic condition of the gall-bladder that in its symptoms resembled carcinoma. The results of the test meal corresponded with carcinoma, as did the condition of the liver itself. The slight jaundice from which the man had suffered had entirely disappeared.

RECURRENT FLOATING CARTILAGE OF THE KNEE-JOINT ("JOINT MOUSE").

DR. ELIOT presented a boy, twenty years old, who was admitted to the Presbyterian Hospital on February 16, 1910. The history he gave was that three years ago, while running rapidly, he turned suddenly at right angles toward the left, using his

right leg to make the turn. He felt a sudden, sharp pain in the right knee joint, and limped home. Since that time he was occasionally seized with a sudden pain in the knee while walking, especially on going down stairs and on marked flexion of the leg. The knee occasionally became swollen. The patient had noticed a movable body in the joint, which he could slip about with his fingers.

He was first admitted to the hospital in December, 1908, and a small, movable, rounded body was made out in the right knee, just external to the patella. An operation was done, and a flattened piece of cartilage, about $\frac{3}{4}$ by 1 by $\frac{1}{4}$ inches in size was removed from the joint cavity. He was discharged cured in January, 1909.

The following September, when swimming or walking, he felt a wobbling sensation in the right knee-joint. This gradually became more pronounced. Sometimes, when walking, the right leg would give way suddenly. He could demonstrate a small movable body just to the outer side of and a little above the patella.

Operation, by Dr. Eliot.—A four-inch incision was made over the outer part of the knee. This was deepened through the capsule, the joint cavity was exposed, and a small loose cartilage about the size of a small olive was removed. The joint cavity, which was not touched with the hands, was then irrigated with saline solution, and closed. The wound healed primarily. After three weeks in bed a plaster case was applied and the patient allowed up on crutches. The knee was in perfect condition at the time of his discharge from the hospital, on March 14, 1910.

RELAXATION OF THE INTERNAL LATERAL LIGAMENT OF THE KNEE, WITH EFFUSION INTO THE JOINT.

DR. ELIOT presented a young man, twenty-four years old, who was admitted into the Presbyterian Hospital on January 25, 1910. Shortly before admission he had fallen, twisting his left knee. He was unable to stand, and had a sharp pain in the knee.

Operation.—A curved incision was made over the internal lateral ligament, which was found to be relaxed but not inflamed. There were evidences of effusion into the joint, which was not opened. The relaxed ligament was reefed from above downward with chromic gut, and the wound was dressed and the joint put

up in plaster of Paris. The wound healed with primary union and the effusion rapidly subsided. The patient was discharged cured on January 25, 1910. On March 1 there was no lateral movement of the joint, although the patient still wore a lateral splint.

APPENDICOSTOMY FOR ULCERATIVE COLITIS.

DR. ELIOT presented a man, twenty-six years old, who was admitted to the Presbyterian Hospital on December 1, 1909, with the history of attacks of dysentery extending over the past three years. An examination showed ulcerations of the rectum and colon, and *Amaba coli* were found in the stools.

Colonic irrigations with solutions of silver nitrate and creolin were given, but without improving the patient's condition, and as there was progressive loss of flesh and strength, an appendicostomy was done. The appendix was about the size of an ordinary lead pencil, and contained *Amaba coli*.

A catheter was introduced into the amputated appendix, and irrigations were commenced the day following the operation, and repeated two or three times daily. For the first three days saline irrigations in large amounts and at a temperature of from 110 to 115° F. were employed. Then a 1-3000 quinine solution was substituted, the irrigation being given once daily. This was followed by an improvement in the character of the fecal discharge, and at the end of a week the quinine irrigation was given every other day. There was a steady improvement in the patient's condition; he gained flesh and strength, the tongue was clean, and the stools nearly normal. The patient had a slight relapse six weeks after the operation. The irrigations were still given once a week. The patient had returned to work.

DR. ROGERS said that in cases of colitis due to the presence of the *Amaba coli* the patients could not be pronounced cured until at least two or three years had elapsed. In one of his cases where an appendicostomy was done three years ago the patient had frequently considered himself well, only to find that the colitis promptly returned when the irrigations were suspended. Dr. Rogers said he had always supposed that the amoeba could not grow on the external skin, but in the case he had in mind the patient had an ulceration on the buttocks, and scrapings from this showed the presence of the parasite.

DR. ELIOT said he had one patient upon whom this operation was done at least five years ago, and who was still obliged, at irregular intervals, to repeat the irrigations. Personally, the speaker said, he believed a permanent opening should be left, as these patients were never beyond the danger of a recurrence of the colitis.

TRAUMATIC ASPHYXIA.

DR. ELIOT showed a man, twenty-three years old, who was admitted to the Presbyterian Hospital on November 20, 1909. The history obtained was that while fixing an elevator door, the weights of the elevator fell, striking his left shoulder. These weights amounted to 16,000 pounds, and as they fell the elevator stopped automatically, so that he was subjected to the weights for a fraction of a second only. At the time of the accident, he wore a soft shirt and collar.

When observed, the patient's face was black, with a sharp line of demarcation running around the neck, separating this darkened area from the normal flesh. He was conscious but dyspnoic, and unable to see with the right eye; the left eye was normal. There were ecchymoses over the thorax, especially over the upper left half. The face was deeply cyanosed (Fig. 1); there were râles in the chest. Pulse, 90; temperature, 99.5; respirations, 24. The pain following the accident was so severe as to require morphine. The patient complained of severe headache for five or six days; after that it became less intense. There was exophthalmos of the right eye, with sub-conjunctival ecchymoses in both. The optic nerve of the right eye was very pale, and showed signs of beginning atrophy.

The patient left the hospital on December 5, 1909, improved. Four weeks after the accident his condition was apparently normal, excepting for complete blindness in the right eye. Dr. Eliot said the unilateral character of the eye symptoms in this case seemed to be due to the fact that the blood could be more easily forced through the right innominate vein than through the left, and that the blindness was due to the forcible transmission of the blood through the veins.

DR. FRANK J. PARKER said that when he had made his first examination of the eyes in this case, which was about two weeks after the patient's admission to the hospital, he found marked extravasation of blood under the conjunctivæ of both eyes, and

FIG. 1.



Dr. Elliot's case of traumatic asphyxia.

slight exophthalmos of the right eye. In the left, which was his good eye, the fields were normal to light, and the rotation of both eyes was normal. The retina was normal, excepting slight dilatation of the veins, and the arteries and nerves were normal. In the left eye, the pupil reacted to light, but very sluggishly. In the right eye the man had no vision whatever—not even perception of light. The optic nerve was atrophied, the condition found being known as “white atrophy.” The veins were tremendously engorged and tortuous, and the arteries were very small. Perception of light was never recovered in this eye, the nerve gradually changing to “gray atrophy,” which was a permanent atrophic condition.

Dr. Parker said the records showed about twelve cases similar to the one shown by Dr. Eliot, but this one was unique in the presence of complete atrophy of the optic nerve. The lesion was probably an effusion of blood into the optic nerve, close to the disc.

SIMPLE FRACTURE OF VERTEBRA, WITH CONTUSION OF THE CORD.

Dr. ELIOT presented a man, thirty-four years old, who was admitted to the Presbyterian Hospital on April 21, 1908. The history obtained was that while trying to board a moving trolley-car he sustained an injury to his spine and was brought to the hospital in an ambulance. There had been no loss of consciousness. After the injury he complained of numbness in the lower extremities and slight pain in the right knee. He could partially flex the right knee, and there was slight movement of the right toes. There was loss of control over the bladder and rectum. No respiratory symptoms.

When the patient was admitted he was in a state of shock. The eyes were normal, with the exception of some ecchymosis under the upper lids and under the left conjunctiva. There was a contusion of the head in the occipital region, but no symptoms referable to the head, ears, throat, tongue, speech, etc., were found. Examination of the spine showed a depression at about the level of the twelfth dorsal vertebra and a corresponding projection of the vertebral spine sharply backward, indicating a dislocation between the fragments of at least three-quarters of an inch in the horizontal plane. This deformity largely disap-

peared when traction was made under an anæsthetic. Above this point there was crepitus and swelling of the soft parts. The abdomen was rigid. The upper extremities were not affected. In the lower extremities there was complete loss of function, with the exception of slight motion of the right toes and partial flexion of the right knee. Sensation in the lower extremities was apparently unimpaired, excepting for slight hyperæsthesia. The reflexes were absent. The penis was erected.

The condition of shock soon passed off, leaving the patient with severe pain in the legs, mostly below the knees. On the day of admission, April 21, 1908, the patient was given ether, while traction was applied to the legs and a plaster case applied to the back. He was then put to bed with extension on the legs and shoulders. The extension apparatus was taken off after 48 hours, for fear of pressure sores. On April 24 he could move the thighs slightly, the right more so than the left. He complained of severe pain in the legs and in the abdomen when the bladder became distended. There was no apparent loss of sensation. On April 27 the motion in the thighs had slightly increased; the reflexes were absent in the lower extremities; both the deep and superficial cremasteric reflexes were present. Temperature, pulse and respiration were normal.

On April 30 the motion in the legs had increased. The pains in the legs had disappeared and there was a sensation of pins and needles in the lower extremities. On May 5 motion in the legs was still further increased, especially in the left. The sense of touch was diminished below the knee, especially on the right side, and over the same area there was a loss of sensation to heat and cold. The reflexes were still absent. On May 15, when the plaster case was removed, an examination of the spine showed no deformity. On the following day the patient voided urine normally for the first time. The bowels were still emptied by enemata. On May 20 catheterization was discontinued, but irrigation of the bladder was still kept up. On May 24 the urine showed the presence of much pus, and there was some fever and vomiting. These symptoms disappeared in the course of a few days, the urine became a little clearer, and the patient's appetite and general condition improved. Motion in the lower extremities gradually increased, and on June 24, which was the patient's sixty-fifth day in the hospital, he was allowed to sit up in a chair

for the first time. On July 2 he could move both legs about in bed and flex both thighs, but he could not lift either foot. He had regained good control of both sphincters.

On July 30, 1908, he was put in a walking machine, but had not sufficient strength to push himself along. There was marked foot-drop on the left side. The right lower extremity was stronger than the left, extension of the left foot being almost *nil*. The knee-jerk was present on the right side; not on the left. No spinal deformity could be made out. The urine was free from pus.

The patient left the hospital on December 9 at his own request. He was recently examined by Dr. M. G. Schlapp, who reported that the left leg was still weaker than the right, especially in the peroneal and quadriceps muscle groups. The knee-jerk was present only on the right side. Babinski was present on both sides, but stronger on the right. The Achilles tendon reflex was present on both sides equally. There was slight disturbance of the pain and temperature sense from a point six inches below the knees down to the feet. There was less disturbance of the tactile sense. Dr. Schlapp's conclusion was that there was a lesion of the cord involving the anterior horns, or a lesion of the anterior roots in the dorsolumbar region.

The chief interest in this case centres in the fact that, notwithstanding the very pronounced dislocation of the fragments (3.4 inch), the spinal cord necessarily subjected to great pressure should not have been more seriously damaged. The unfavorable result of the operative treatment of this group of cases by laminectomy is well known, and in those rare instances when this operation is said to have been of benefit, the query naturally arises whether equally favorable results might not have been obtained by conservative treatment only.

TUMOR OF THE SPINAL CORD.

DR. OTTO G. T. KILIANI presented a woman, fifty years old, who was brought to the German Hospital by ambulance on April 25, 1908. There was complete loss of power in the lower extremities, and severe pain in the back upon the slightest motion. Her symptoms dated back eight years, when she had an attack of malaria which confined her to bed about three weeks. Shortly after this she complained of pains under the left ribs and in the

spinal region, which became so severe that sedatives were necessary to relieve her. About eighteen months ago she first began to complain of pain in the left lower extremity, and about the same time she noticed that the right leg was cold and numb. These sensations of paræsthesia soon also involved the left leg, as well as the lower abdomen. Subsequently, there was loss of power in both lower extremities.

The symptoms in this case, Dr. Kiliani said, led to the diagnosis of an extramedullary intradural tumor of the cord, involving the eighth and ninth dorsal segments, and an operation was done in May, 1908. Upon exposing the dura in the region indicated, it was observed that it did not pulsate, and its puncture and incision was followed by the escape of only a moderate amount of cerebrospinal fluid. No tumor was found, but the entire pia was studded with small disks, resembling mother-of-pearl, which were afterwards demonstrated to be composed of cholesterin. This condition, the speaker said, he had never before observed, and at the time it led to the suspicion that he was dealing with a meningitis. The opening in the canal was then lengthened upwards, and under the sixth and seventh dorsal segments he found a tumor, which was shelled out without much difficulty or loss of blood. It was encapsulated, and moderately adherent to the dura. Following its removal, there was a free flow of cerebrospinal fluid. The dura was entirely closed with catgut. The wound healed primarily, and the patient made an uneventful recovery. There was a gradual improvement in her symptoms, and she was now able to walk fairly well.

This case, Dr. Kiliani said, had been reported by him *in extenso*, with illustrations, in the "Festschrift" issued in connection with the fortieth anniversary of the German Hospital in New York, in 1909.

TUMORS OF THE SPINAL CORD.

DR. GEORGE WOOLSEY read a paper with the above title for which see page 289.

DR. J. RAMSAY HUNT said he thought the results referred to by Dr. Woolsey were the most favorable that had thus far been reported. Out of six consecutive cases of extramedullary tumors of the cord, there had been four practical cures, a successful extirpation with recurrence and only one death.

In addition to the cases reported by Dr. Woolsey, the speaker

said he had seen seven other cases of tumor in or about the cord during the past ten years in which the diagnosis was verified by operation or autopsy. The general diagnosis of tumor in these cases was comparatively easy: the difficulty lay, not in recognizing the fact that we had to deal with a tumor, but in determining the relation which the tumor bore to the cord itself: *i.e.*, whether extramedullary or intermedullary, and, in the latter event, in all probability, inoperable. It was easy to make this distinction in some cases, while in others it was practically impossible.

The feeling was growing, Dr. Hunt said, that an exploratory operation should in the future be done in many more of these cases, and at a much earlier period than had been done heretofore. Of course, the most favorable time for the tumor to be removed was when the symptoms of compression of the cord were first apparent. None of his own cases had come under his observation at such an early date, which showed how backward the general practitioner was, as a rule, in recognizing the true nature of this condition. They were usually allowed to go on until advanced paraplegia had developed. Errors were often made in the interpretation of the root pains and cases have been operated upon for gall-stones, pelvic troubles and appendicitis, when the real nature of the trouble was a spinal tumor, compressing the posterior roots and causing persistent pains of segmental distribution.

Dr. Hunt said there were other conditions of the spinal cord which might simulate tumor. Chief among these were myelitis, multiple sclerosis with localized lesions in the cord and syringomyelia. Rarely, tumors of the cord were situated anteriorly on the surface, so that in their growth they would naturally compress the motor tracts and nerves, sensory symptoms remaining in abeyance. The so-called meningeal cyst might also give rise to symptoms of tumor: they may exist alone or associated with conditions inside of the cord. The speaker emphasized the occasional occurrence of cerebral symptoms and optic neuritis in cases of high cord tumor. It was thought these symptoms were produced by a mild grade of hydrocephalus, due to the damming back of the cerebrospinal fluid. He had no doubt that some of the fatal cases that had been reported during or immediately following operation were to be ascribed to the sudden discharge of cerebrospinal fluid in a brain that had been distended.

Discussing the case that had been shown by Dr. Eliot, the

speaker said he had seen a great many cases of fracture-dislocation of the cord, and he had never observed any encouraging results from laminectomy in those cases. The rule he had laid down in dealing with this condition was a fairly conservative one. If the anæsthesia and paralysis were complete, and the motor and sensory symptoms corresponded in level, he did not advise operation, believing that under those conditions the cord had been crushed and an operation could be of no particular benefit. If, however, the anæsthesia and paralysis were incomplete, and the motor and sensory symptoms were irregular and did not correspond, then he assumed that the cord was not completely crushed, and that an operation done immediately or within forty-eight hours was justified and might prove beneficial. In the treatment of these cases he did not believe in extension, and he had even seen fatal results follow accidental movement of the spine. If severe traction was to be done under anæsthesia, the spinal cord should first be exposed.

DR. CHARLES A. ELSBERG said that about two months ago he had removed a fibrosarcoma involving the third, fourth and fifth cervical segments, and that the patient was now making a good recovery. In that case he had found it necessary to divide the operation into two stages. Upon opening the spinal canal he had made out a hardening of the cord, and he thereupon incised the dura in order to be certain that he was dealing with a tumor. In doing this he injured the pia arachnoid, and upon inspecting this, a bit of brownish tumor material was seen bulging through the opening. The patient's condition at this time became so precarious that the operation was discontinued. One week later, when the second stage of the operation was undertaken, he was exceedingly surprised to observe that the pia had ripped open, and that the tumor, which was very large, was extruded from the cord and required practically no manipulation to remove it.

In a subsequent case, Dr. Elsberg said, he resorted to the same procedure, merely opening the dura during the first stage of the operation, and finding the tumor bulging through the opening when the second stage was undertaken. He suggested that the method might be applied in cases of brain tumor, making a small incision in the dura and cortex, and at the second operation finding the tumor practically extruded outside of the brain.

Stated Meeting, April 13, 1910.

The Vice-President, DR. CHARLES L. GIBSON, in the Chair.

OSTEITIS DEFORMANS, WITH PATHOLOGICAL FRACTURE
OF THE RADIUS.

DR. JAMES I. RUSSELL presented a man, 55 years old, in whom, eighteen years ago, both big toes became suddenly swollen in the night, and were red, tender, and painful. His illness did not prevent him from working, and he had entirely recovered at the end of one week. Each succeeding summer for several years he had similar attacks, affecting one or the other great toe.

Sixteen years ago he had a sudden attack of pain in the lumbar region, lasting for three days. Similar attacks recurred each winter with increasing severity. About the same time he noticed that he could not abduct his thighs as well as formerly, and that motion had become steadily more limited. Three years later he had a very severe attack of pain in the lumbar region, radiating into the thighs. This kept him in bed for a month, during the last week of which he had pain and swelling in the left ankle.

During the following seven years, although he was able to work, he noticed a general failure in strength. His back became weaker and began to bow forward. The weakness extended to the thighs and legs, his gait changing to a "bandy or hippy walk," as he expressed it. Six years ago, the spinal deformity having increased and the feeling of falling forward being so marked, he began to walk with the aid of a cane. During the past four years the arms had become weaker, and the head had steadily increased in size. For three years he had used a crutch on the right side, and during that time there had been developing an outward bowing of the right forearm.

On March 23, 1910, while leaning on his crutch, the latter slipped, and during his effort to draw the crutch inward to support the body he heard a snap in the right forearm which was accompanied by sharp pain. The following day he came to the Out-Patient Department of Roosevelt Hospital, where an X-ray picture was taken which showed a fracture of the radius, with a marked dorsal curve and pathological changes in the bone.

At the present time the patient had the characteristic symptoms and bony changes described by Paget in 1877, namely, the attitude and gait; the head was disproportionately large and bowed forward, with the chin almost on the chest. The clavicles were very prominent, the back was bowed; both femurs were bowed outwards, and the tibia forward and outward. The radial arteries were very rigid, and could be seen in the X-ray plate of the forearm.

The etiology of osteitis deformans, Dr. Russell said, was unknown. It was always associated with marked arterial sclerosis, and often with malignant tumors. It affected the sexes about equally. As to its pathology, Steele, who carried the case of Packhard, Kirkbride, and Steele to a fatal termination, offers the following conclusions: "1. Absorption of the compact substance, causing enlargement and confluence of the Haversian canals. 2. Formation of new bone running diffusely through affected and healthy portions. This new bone remains uncalcified and is reabsorbed. 3. The conversion of the medullary substance into vascular connective tissue containing fat cells, giant cells, and leucocytes. 4. As consequence of these three processes, the ordinary relations of the compact substance and medulla are destroyed. The bones become thickened and asymmetrical, but since the new bone tissue remains uncalcified, its elasticity permits of great deformity, etc., and fractures do not occur."

SUBPERIOSTEAL RESECTION OF THE TIBIA FOR OSTEOMYELITIS.

DR. RUSSELL presented a boy, 6 years old, who was admitted to the Roosevelt Hospital, in the service of Dr. George E. Brewer, on March 2, 1909.

His present illness began one week before admission with pain and swelling in the region of the right knee. There was no history of injury. The patient complained of a sharp pain in the right leg, extending from the knee to the toes. It was worse at night. In a few days the leg became swollen, reddened, and tender, especially just below the knee. Movement at the knee-joint was painful, and examination showed a red, tender, fluctuating area on the anterior surface of the tibia, below the knee.

Operation (March 2, 1909).—An incision was made through the soft parts of the periosteum, and a portion of the cortex on

the anterior surface of the tibia was removed. This revealed an abscess cavity, which was drained. The boy's condition immediately improved. His temperature, which had been high, gradually fell, reaching 99° on the sixth day, from which time it fluctuated between 99° and 100° until the twenty-seventh day, when he developed marked tenderness and some œdema over the lower part of the tibia. Two days later the skin and soft parts were divided over the anterior surface of the tibia. The periosteum was much thickened throughout its whole extent. A small trephine opening was made just above the lower epiphysis, and the medullary cavity was found to be infected. The periosteum was then split from epiphysis to epiphysis, and the tibia removed subperiosteally from just below the upper to a point just above the lower epiphysis. The periosteum was then sutured with interrupted catgut, the wound was closed, and a plaster case applied. Five weeks after this operation, the patient fell from a chair, fracturing his right femur, for which a case was also applied.

The patient made a slow but uneventful convalescence, and was discharged, cured, on March 4, 1910, one year after his admission.

In connection with this case, Dr. Russell exhibited a number of X-ray plates, taken each three weeks after the operation, which showed the development of the new tibia; they also showed the fractures as they occurred and were repaired in the new bone during the course of its development.

DR. CHARLES H. PECK said he had watched this case for a number of months during the patient's stay in the hospital, and was very much interested to see the reformation of the shaft of the tibia until the patient was now able to use the limb. The case was a good illustration of the power of the periosteum in the reformation of bone.

SARCOMA OF THE CLAVICLE: TOTAL EXCISION.

DR. WILLIAM B. COLEY presented a boy, 16 years old, whose family history was good and who had always been well until the beginning of October, 1909, when in going down stairs he tripped and fell. Trying to save himself, he caught hold of the banister with his left hand, which brought him up so suddenly that it caused a good deal of strain upon his left shoulder and clavicle.

Shortly afterwards, while riding a motor cycle, the latter broke down and he was obliged to tow it for a distance of ten miles, during which time he held on to the tow iron with the left hand. Towards the end of October he first noticed pain and soreness in the region of the left clavicle, but he did not observe any swelling until a week later. On November 20, 1909, he consulted Dr. Alfred Potter of Brooklyn, who found a fusiform enlargement of two-thirds of the inner portion of the shaft of the left clavicle, and an X-ray was made, which gave the appearance of a typical periosteal sarcoma. The tumor was about the size of an English walnut. No enlarged glands were present. The patient's general health was good; there was very little pain.

Early in November, 1909, Dr. Coley did a total excision of the left clavicle. The patient made an uninterrupted recovery, and left the hospital at the end of ten days. Before leaving the hospital he was put upon the mixed toxins of erysipelas and *Bacillus prodigiosus* in small doses, and these have been continued by his family physician. At the present time, five months after the operation, the patient is in perfect health.

Dr. Coley said that this case would be reported in full in the ANNALS OF SURGERY, in connection with a paper upon the total excision of the clavicle for sarcoma, with end results.

INTERSCAPULOTHORACIC AMPUTATION FOR SARCOMA OF THE HUMERUS.

DR. COLEY presented a boy, 10 years old, whose family history was good and whose past history had no distinct bearing on his present condition. About eight weeks ago he began to complain of slight pain in the region of the left shoulder, elbow, and wrist. Three weeks later he fell on the ice, striking on his left shoulder and upper arm. The arm became useless and the patient was seen by the county physician, Dr. Young, who found a swelling of the upper end of the humerus, loss of power, and evidence of fracture. He put the arm in card-board splints. Three weeks later there was an increase of callus; examination a week later showed marked increase in size. The patient was then seen by Dr. Bellis of Trenton, N. J., who found a very large tumor of the upper end of the humerus with enlargement of the veins. This increased with great rapidity. The patient was then referred to Dr. Coley; examination at this time showed the left humerus

enormously enlarged in its upper third, presenting the appearance of a typical sarcoma; the tumor extended from the pectoral muscle to the middle of the clavicle and posteriorly to the edge of the scapula.

An interscapulothoracic amputation was done. The patient made a good recovery, and was put on the mixed toxins. He was in good health at the present time.

DR. L. W. HOTCHKISS said he had seen a somewhat similar case of sarcoma of the head of the humerus in a young boy, for which he had done an interscapulothoracic amputation. The curious features in this case were that the sarcoma had evidently been mistaken for an inflammatory condition by the physician in charge, and had been incised. The incision had been followed by a rapid local infection, which, upon the patient's admission to the hospital, was recognized as a gas bacillus infection, and was treated by free incisions and irrigations with antiseptic solutions, principally peroxide of hydrogen and formalin. The infection did not become general and the patient recovered. Curiously, the growth in the humeral head seemed to decrease in size at first, presumably as a result of the gas bacillus infection, but when this cleared up it rapidly increased in size, and an amputation was done several weeks later. Death from recurrence, but not local, occurred in a few months.

The suggestive feature about the case was the apparent shrinkage in the growth as a result of the gas bacillus infection, and its rapid increase after the patient recovered from this.

DR. COLEY, speaking of the last two cases shown, said that in the case of total excision of the clavicle for sarcoma, the operation had been done within three weeks after the onset of the symptoms, and in the case of sarcoma of the humerus the operation was done within two or three weeks after the onset of the symptoms. An interesting feature of the cases was that the clinical and pathological signs of malignancy differed materially. In the humerus case, Dr. Ewing reported that the growth was a giant-celled sarcoma of a low degree of malignancy, while as a matter of fact its growth proved to be very rapid.

Dr. Coley said that in two other cases of sarcoma of the humerus where he had done an interscapulothoracic amputation, the patients had died of a recurrence in the spine. In another

case he found the subclavian vein filled with thrombi. That patient was put upon the mixed toxins and lived for about a year, when she died of metastases in the lung.

AMPUTATION OF LEG FOR SARCOMA OF FOOT FOLLOWING FORCIBLE CORRECTION OF FLAT-FOOT.

DR. COLEY showed a boy, 16 years old, who was apparently perfectly well until December, 1909, when he came to the Hospital for Ruptured and Crippled for flat-foot, in the service of Dr. Wisner R. Townsend. Both feet were forcibly stretched and placed in plaster of Paris in a position of marked adduction. At the end of two or three weeks, when the plaster was taken off, a well-marked tumor was noticed below the external malleolus of the right foot; it was a smooth, symmetrical, rounded tumor, projecting about half an inch above the surface, and firmly fixed to the underlying structures. The skin was normal. The tumor grew rapidly in size, and when Dr. Coley was asked to see the case it presented an appearance similar to that just described, only somewhat larger. The overlying skin was normal, excepting that the veins were slightly enlarged. In consistence the tumor was soft but not fluctuating; it was firmly fixed, but apparently not connected with the bone.

A diagnosis of sarcoma was made both by Dr. Townsend and himself, and the patient was sent to the General Memorial Hospital. Under ether, Dr. Coley made an attempt to remove the tumor, which proved to be a highly malignant, extremely vascular sarcoma, originating in the ligaments below the malleolus, and extending down to but not involving the periosteum. The tumor had infiltrated the tissues in all directions beneath the tendons and fascia, involving an area about three inches in diameter. It was impossible to effect its complete removal, but, in the hope of saving the leg, it was decided not to amputate at once, but give the patient two or three weeks' trial with the toxins. This was done, and for a short time there was marked improvement, but at the end of three weeks, the growth again increasing, an amputation was done between the middle and lower third. The wound healed by primary union, and the patient was again put upon the toxins a short time after the operation.

SMALL ROUND-CELLED SARCOMA OF THE NECK.

DR. COLEY presented a man, 41 years old, a heavy smoker, who first noticed a lump in the submaxillary region in April, 1909. This grew rapidly, and by June had reached the size of a hen's egg. His family physician, Dr. Lipset, at first regarded the trouble as an infiltrated gland and treated it with poultices for two weeks, and later lanced it, but only blood was found.

On June 11, 1909, the patient was admitted to the Roosevelt Hospital to the service of Dr. Peck, who stated that he found a very vascular tumor which had invaded the periosteum of the lower jaw. There was also marked infiltration of the muscles and skin. Dr. Peck could not make a complete removal, and gave a hopeless prognosis. A microscopic examination was made by Dr. Hodenpyl, the pathologist to the hospital, and he pronounced it a small, round-celled sarcoma, highly malignant.

The patient was referred to Dr. Coley a few weeks after operation for the toxin treatment, and this was carried out under his direction by Dr. Lipset, the family physician. The patient was at first given four injections a week; later, twice a week and then once a week, and, during the last two months, once in two weeks. The total number of injections given was 56.

Shortly after the treatment was begun, the infiltrated area in the region of the cicatrix gradually softened and receded, and at the end of three months it had entirely disappeared. The patient has remained well up to the present time, eleven months after operation. There is no trace whatever of the disease at present, and he is in perfect general health.

DR. PECK, discussing Dr. Coley's case of sarcoma of the neck, said that when he operated on the patient last June, the tumor was of six weeks' duration. There was considerable infiltration of the skin, and only an incomplete excision was possible. The growth was reported as a round-celled sarcoma, and as a prompt recurrence was expected, the patient was referred to Dr. Coley for injection of the mixed toxins.

BRAIN ABSCESS, SECONDARY TO PELVIC SUPPURATION.

DR. CHARLES H. PECK presented a married woman, 22 years old, who was delivered of her first child three weeks prior to her admission to the Gynecological Service of Dr. George M. Tuttle,

at the Roosevelt Hospital, on October 31, 1909. The history obtained was that instrumental delivery was followed five days later by a chill, fever, and abdominal pain, which continued up to the date of admission. A large abscess in the left lower abdomen was opened and drained on November 10, 1909, at about 2 P.M. At 3.45, 5 and 9 P.M. of the same day muscular twitchings of the right arm and leg were noted. Twitchings of the same character, lasting several minutes, were noted on November 11, at 6.15 A.M., and on November 12, at 1.00 A.M. On the two following days there was considerable rhythmic twitching, and weakness was noted on the entire right side. On November 17 she first began to complain of severe left-sided headache, frontal and parietal, and vomiting set in. On the next day the headache continued, she vomited twice, there was no twitching, but the right-sided paresis persisted, and the pulse, which had previously ranged between 80 and 96, dropped to 60. The temperature had never been above 100° since the abscess was drained.

The patient was transferred to the Medical Division, in the service of Dr. Evan Evans on November 18, and the next day the following examination was recorded: The patient is a woman of small frame, anæmic, conscious but drowsy; speech slow and deliberate; answers questions slowly.

Eyes: No strabismus; movements normal; right pupil slightly larger than left. With the ophthalmoscope an examination of the right fundus showed the outline of the disc indistinctly, especially to the right; no hemorrhages; macula was seen very clearly. In the left fundus the outline of the entire disc was blurred; vessels tortuous and in the upper part obliterated by œdematous disc; no fibrillation; moderate degree of choked disc; no hemorrhages.

The ears were normal. The tongue deviated to the right on repeated examinations. The right face was slightly flattened; emotional motor paralysis was marked. There was marked weakness of the right arm and leg; the patient was unable to hold up her arm and the grip was much weaker than on the left side. There was a glove-like area of diminished common sensibility in the right hand, extending up to the wrist; marked astereognosis in right hand. The left side of the body and extremities were normal. The wrist, knee, and elbow reflexes were absent on

both sides; no Babinski; slight rigidity of neck; Kernig sign positive. There was fairly well-marked cranial tenderness over the left coronal suture, midway between the base and the vertex; some tenderness over the left frontal sinus.

Dr. Evans made a diagnosis of cerebral abscess, subcortical, in the ascending frontal convolution, near the arm area, exerting pressure on the fibres from the psychosensory area and astereognostic centres in the ascending parietal convolution, and on the anterior portion of the optic thalamus. The patient remained in the medical ward from November 18 to November 21. During this time her temperature ranged from 96.8° to 99° ; pulse, from 56 to 72; leucocyte count, from 9300 to 14,300.

On November 21 the patient was transferred to the Surgical Service and operated on by Dr. Peck. A continuous catgut suture was taken through the scalp to control hemorrhage, and a curved flap was made with its base reflected downward. A trephine opening was made over the centre of the Rolandic fissure, and the opening enlarged with a rongeur. A small incision was then made through the dura, and an exploring needle inserted. With the third puncture, about two drachms of thick, yellowish pus was obtained at a point a little behind and slightly above the middle of the fissure, at a depth of an inch and a half or two inches beneath the cortex. Cultures from this pus gave a pure growth of *Streptococcus pyogenes*. A blunt dressing forceps was inserted along the track of the exploring needle, and was partly opened upon its withdrawal, but no considerable quantity of pus was obtained. A drainage tube was then pushed through the brain substance to the site of the abscess, and the dura, periosteum, and flap were sutured around the tube. The brain surface showed nothing abnormal on palpation or inspection.

The patient rallied well from the operation, and on November 24 she had begun to show marked improvement in her mental state and increased power in the right arm and leg. Her temperature was only once above 99.8° , and the pulse ranged from 72 to 100. No pus ever discharged from the drainage tube, and none could be obtained by exploring with a grooved director and slender dressing forceps in the depths of the tract on removal of the tube on the sixth day after operation. Improvement seemed to come to a standstill after about ten days. In the meantime, a hernia cerebri had developed, and had increased somewhat in size. The wound healed without infection.

On December 10, an examination of the eyes showed a decided choked disc on the left side, with an elevation between 1 and 2 mm., and venous hemorrhages to the superior and nasal side. On the right side there was choked disc, with an elevation of from 1 to 2 mm. On December 13 a note was made that the hernia cerebri was about the size of half a lemon. The headaches persisted, and there was no increase in power in the right arm and leg. The patient became much depressed and very homesick, and on December 20 she insisted on going home, against advice. At home her spirits and general condition improved greatly, but her other symptoms persisted practically unchanged until December 26, when a considerable quantity of pus escaped from the hernial mass.

On January 12, 1910, a note was made that since the discharge of pus the paralysis had greatly improved, the patient now being able to walk a few steps and raise her right hand to her face. Her vision was also much better, as were the headaches; the astereognosis was still present. On February 18 the cerebral hernia had entirely disappeared, and all the symptoms had greatly improved. On March 20, when she came to the hospital with her husband to report progress, her mentality was perfectly clear, she was bright and happy, and had gained twenty pounds in weight. Her vision and the eye-grounds were normal, the choked disc having entirely disappeared on both sides. There was still slight facial paralysis and right hemiparesis, although the muscular power in both arm and leg had greatly improved and she walked well with a slight limp. Right astereognosis was still complete, but the glove-like area of anæsthesia had disappeared.

. Dr. Peck said the case seemed of interest on account of the rarity of a cerebral abscess secondary to pelvic suppuration being single and amenable to treatment, and on account of its accurate localization prior to operation by Dr. Evans's careful and thorough study of the case. The evacuation of the abscess at the time of operation was evidently imperfect, and owing to its small size and great depth from the brain surface, its attempted drainage while the patient remained in the hospital was unsuccessful, but a track was established along which the pus subsequently found its way, appearing at the surface of the hernia.

SUPPURATIVE CHOLANGITIS; PANCREATITIS; HEPATIC DRAINAGE.

DR. PECK presented a man, 60 years old, who was awakened on the morning of February 20, 1910, at 2 A.M., with a severe, lancinating pain in the upper abdomen, radiating through to his back, followed by chilliness and fever, and on the next day by jaundice. The fever and steadily deepening jaundice continued, and he was admitted to the Medical Service of the Roosevelt Hospital on February 23. His temperature ranged up to 104.4°; the skin and conjunctivæ were deeply icteric, the stools were clay-colored, and the urine loaded with bile. There was marked tenderness and some rigidity on deep pressure over the region of the gall-bladder and ducts. A blood count showed 10,000 leucocytes, with 70 per cent. of polynuclear cells. The patient was transferred to the Surgical Service on February 24 and operated upon at once, the diagnosis being stone in the common duct, with cholangitis. The man stated that he had had attacks of gall-stone colic twenty years ago.

Operation.—A vertical incision was made through the upper part of the right rectus. The liver was swollen and dark in color, with rounded edges, very tense on palpation, and showing some evidence of perihepatitis along the edges of the right lobe. Neither gall-bladder nor ducts could be seen for some time. The pylorus was tightly adherent to the under surface of the liver by dense adhesions. The head of the pancreas was uneven, hard to the feel, and considerably thickened. The posterior peritoneum to the right of the duodenum was incised, and this organ was then lifted and rotated to the left, exposing the posterior surface of the head of the pancreas. No stone could be palpated in the lower portion of the common duct.

The adhesions of the pylorus and upper duodenum to the under surface of the liver were then divided and separated with great difficulty, and a structure which looked like an enlarged common duct was exposed. Incision into this proved the part next to the liver to be a diminutive, shrunken gall-bladder, and below it the common duct. A probe passed easily into the duodenum and upward into the hepatic duct, no stone being found. Bile streaked with pus escaped when the duct was incised, and cultures from this showed the *Staphylococcus aureus*. A drainage tube was passed into the hepatic duct and secured with a fine

catgut suture. A large tube was passed down to the opening in the gall-bladder and duct, and a large rubber tissue and gauze drain below in Morrison's pouch. The wound was then carefully sutured excepting at the exit of the drains.

Bile drained freely from the tubes, from 126 c.c. to 415 c.c. each twenty-four hours. Both the jaundice and the constitutional symptoms improved steadily. Bile passed on into the intestine very soon, for on the third day the patient had a yellow, liquid stool. By the sixth day the temperature had fallen to normal, the stools were normal in color, and the jaundice had entirely disappeared. The duct drain was removed on the tenth day, and bile continued to discharge through the wound until the twenty-third day, when it entirely ceased. The patient was allowed out of bed on the twenty-eighth day, and left the hospital a week later, cured.

Speaking of this case, Dr. Peck said there had evidently been a chronic cholecystitis, probably associated with gall-stones, present for years, as shown by the shrunk gall-bladder and the dense, old adhesions. The pancreatitis seemed to be confined to the head of the pancreas, and was subacute or chronic in type, as no fat necrosis nor evidence of acute inflammation was seen. The cholangitis was acute, with tense engorgement of the liver, and a distinct streaking of the bile with pus as it escaped through the incision in the common duct. Cultures taken from this pus showed a growth of *Staphylococcus aureus*. As this is a most unusual organism to find in this location, it was possible that contamination occurred through some error in technic, although care was taken to prevent this, and the fluid was obtained directly from the opening in the duct. As no calculi were found and there was no demonstrable mechanical obstruction in the ducts, the cause of the acute onset of the cholangitis was uncertain. The prompt relief of symptoms afforded by the hepatic drainage was striking, in view of the apparent violence of the cholangitis and the seemingly hopeless outlook.

HYDRONEPHROSIS FROM VALVULAR URETERAL OBSTRUCTION; PLASTIC OPERATION ON KIDNEY PELVIS.

DR. PECK presented a man, 39 years old, an engineer, who was admitted to Roosevelt Hospital on February 6, 1910, with the history of having had during the past year several attacks of

pain in the right lumbar region, all similar in character. The last one began ten days before admission with pain at the right costovertebral angle, not radiating to the thigh, groin, or testicle, and later tenderness on pressure in the same area. He had also suffered from nausea, and had vomited once. The pain, nausea, and tenderness recurred at intervals of two or three days until admission. It was somewhat relieved by hot applications or hot tubs. There was no history of increased frequency of urination or of sudden variations in the amount passed, nor had he observed any sand or gravel or blood in the urine. He had never been jaundiced nor passed clay-colored stools. The pain at the costovertebral angle was never violent, but dull and distressing in character. In two of his previous attacks he had what he described as a "sore line" (not a radiating pain) from the right costovertebral angle to the right testicle. Repeated analyses of the urine had proved negative. On four occasions he had had left-sided pain, but less severe than on the right, and without tenderness. His general health was not impaired, and his appetite and digestion remained good. There were no constitutional symptoms. Blood examination negative. Physical examination was negative, with the exception of an area of slight tenderness at the right costovertebral angle and on palpation of the kidney region. No mass could be felt. An X-ray of the kidney region was negative.

A cystoscopic examination was made by Dr. Edward F. Kilbane on January 31, 1910, who reported as follows: The bladder urine was clear in gross. The bladder was able to hold eight ounces of fluid without discomfort. Its mucous membrane was normal. The prostate was enlarged and nodular; the division between the lobes could not be made out, but the gland projected as a whole into the bladder for a considerable distance, forming quite a fossa behind. Both ureteral orifices and the entire trigone were carried forward into the bladder by the prostate. The left ureteral orifice was normal in appearance, and a catheter was easily passed to the pelvis. Urine started to flow immediately, and the rate of flow was rapid. At first the urine was considerably blood-stained, probably due to trauma; later it became much clearer. Indigo-carmin appeared within ten minutes.

The right ureteral orifice appeared to be œdematous, and it

was difficult to introduce the catheter, which met with several obstructions and could not be passed beyond a point twelve inches from the orifice. Pressure of the catheter at this point caused pain, which was referred to the head of the penis. The catheter on the opposite side passed three inches further. Several catheters were introduced on the right side with the same result. A small quantity of urine was collected from this side, which contained a large proportion of pus.

After withdrawal of the catheters, both orifices were observed for some time. The left side secreted at frequent intervals, with considerable force, a good-sized stream deeply stained with indigo-carmin. From the right side there would occasionally come a small quantity of lightly stained fluid. This came with very little force.

Cystoscopic Diagnosis.—Prostate somewhat enlarged. Left kidney showed good functional activity; right ureteral obstruction; kidney on that side probably infected. These observations were confirmed on February 2, when the right ureter excreted a decidedly blood-stained fluid three times per minute.

Exploration of the right kidney region was decided upon, and the operation was done on February 7, 1910. The kidney was explored through an oblique lumbar incision, and delivered with some difficulty owing to adhesions to the capsule at the upper pole. The pelvis of the kidney was found to be tense and much dilated, pouching down behind the ureteral implantation in such a way as to cause complete valve-like closure of its upper orifice. No stone could be felt. An incision was made through the cortex at the convex border into the pelvis, where a small stone was discovered and removed. It was not lodged in the ureteral orifice at the time of operation. With the collapse of the pelvis the kink in the ureter straightened out, and a spiral kidney probe was passed from the opening in the cortex through the pelvis and ureter into the bladder without difficulty. An elliptical segment was then excised from the pouching part of the kidney pelvis, and the wound closed with two tiers of No. 0 chromic gut. This obliterated the pouch and corrected the faulty implantation of the ureter. The long probe was left in the ureter to prevent further kinking when the kidney was replaced, and the wound sutured. A rubber drainage tube was passed into the pelvis through the wound in the kidney cortex, alongside the probe, and two mat-

tress sutures of heavy plain catgut were passed through the kidney substance and lightly tied, one of them around the tube. These controlled all hemorrhage. The kidney was replaced and the wound closed in the usual way. The end of the flexible probe was bent down over a gauze pad and secured with adhesive plaster. This probe was removed without difficulty at the end of twenty-four hours. Drainage through the tube amounted to only a few ounces, and it was removed on the fifth day. The wound healed cleanly; all sutures were out by the seventh day and all drainage from the wound had practically stopped by the eleventh day, when the patient was allowed out of bed. When he left the hospital, on the thirteenth day after operation, he was passing from 60 to 80 ounces of normal urine per day, and he had remained perfectly well since.

On April 11, 1910, cystoscopy by Dr. Kilbane showed both ureteral orifices normal, the right secreting three or four times a minute, a good-sized stream being sent out with considerable force. The wound of the kidney pelvis had evidently healed without leakage.

It was altogether probable, Dr. Peck said, that the obstruction was originally caused by the calculus, which was just about of a size to lodge at the ureteral orifice and obstruct it. After the dilatation of the pelvis had occurred, however, the pouching produced a valvular action which was sufficient in itself to cause complete obstruction. The temporary introduction of the metal probe while the kidney was replaced, and until fixation without kinking was secured, he believed was of assistance in the effort to restore the patency of the ureter.

MYELOMA OF THE LONG BONES.

DR. FRANK S. MATHEWS read a paper with the above title, for which see page 388. In connection with his paper, Dr. Mathews showed a number of cases illustrative of the same.

DR. CHARLES N. DOWD said the communication of Dr. Mathews was among the most important which the Society had recently had. The Society had always shown great interest in the general subject of sarcoma, and probably no one had more keenly appreciated the difficulties and possibilities of the subject than the late Dr. McCosh. As long ago as 1897, while considering the way in which cures have followed incomplete operation for sarcoma, he stated that "we have yet a great deal to learn

about sarcoma," and in 1904 his interest in the subject was so great that he presented to the Society a tabulation of 125 cases of sarcoma that had come under his personal care.

In that paper, after discussing the unsatisfactory state of our knowledge of this subject, he said that he had no doubt, "but that in another quarter of a century, the class of *neoplasms* that we know as *sarcomata* would be divided into many other distinctive groups, very probably with entirely new names;" and in the same paper he stated that "this whole subject is at the present day so vague and unsatisfactory, that I do not know a richer field for research, and I have been surprised that more of our younger clinicians and pathologists have not persevered in their investigation of this subject."

But after a careful consideration of his topic, with the aid of competent pathologists, he had to be content with dividing his observations according to the shapes of the cells, and the inclusion of myxomatous, lymphatic, and fibrous tissue, studying the history of these groups, as they were located in the different portions of the body.

Dr. Mathews' consideration of *myeloma*, so far as the speaker knew, was the pioneer effort in this Society to separate a group of benign tumors from that indefinite class which we call *sarcoma*, and this separation is exactly in accord with the process which Dr. McCosh foresaw several years ago.

We are not sure how definitely this group can be separated, but we may well be convinced that there is such a group; a very large number of so-called *benign sarcomas* have been reported.

In every general discussion on the subject, we find one or more surgeons relating instances of cases which have recovered after very incomplete operations; usually these recoveries have resulted to the surprise of the surgeon, but there have been so many of them that we must believe in their existence.

Several surgeons have done much to add to our knowledge of the peculiarities of these growths. König, for instance, many years ago called attention to those cases of bone sarcoma which contained many giant cells, and he cured a number of them by curetting and chiselling.

Mikulicz, in 1895, advocated resection for certain sarcoma of the long bones rather than amputation, and Bloodgood has studied the question most thoroughly, and has found that conservative operations, for a large number of cases, are successful.

From a pathological stand-point, Adami and Sutton give their pathological endorsement to this group of tumors. The proof is still more conclusive, if, in addition to this, pathological and clinical and surgical studies are continued as shown in the present paper. One must appreciate that much has been accomplished toward the practical separation of one group of benign tumors from the so-called sarcomas. In clinical work, there are two guides in dealing with these growths: one, clinical observation, the other, the report of the pathologist.

In the past these have often been contradictory; for instance, while the second case which is here reported suffered from disturbance in the tibia for three years, the symptoms were very annoying for only three months. The patient was taken to a very able orthopædic surgeon, who believed that the condition was probably a bone abscess, in spite of the X-ray appearance; hence, the clinical study indicated either a benign process or a sarcoma of a very low grade of malignancy, but the pathologist reported it sarcoma, and anxiety was felt about the future of the patient for several years, although the amputation was done just below the middle of the femur, but well above the infiltrated tissue.

The third case was kept under observation for a considerable period after operation. It had been considered a growth of granulation tissue, but the report was definite for sarcoma. A careful consultation was held with the parents and the physician as to the advisability of amputation. The boy, however, was using his leg perfectly well, playing ball, running bases, and doing the other things which healthy boys do, and the result has shown how wise it was to depend on the clinical rather than the microscopical examination.

In endeavoring to separate these cases, surgeons will therefore have to be guided by both clinical and microscopical reports; and until it is possible to know more definitely just which are benign, the use of the mixed toxins may be advocated in their treatment after operation.

DR. WILLIAM B. COLEY said he agreed with Drs. Mathews and Dowd that it was important to try and differentiate from the group of ordinary sarcomas these so-called encapsulated central growths of the bones, which were in many cases benign or so slightly malignant that a local operation was all that was necessary in many of them. Thus far they had been grouped as periosteal or central sarcomata or myeloids. The speaker said

he did not wish to imply that all of these were non-malignant. In Bruns's clinic, among 53 cases of tumors of the long bones, 9 were well three years after the operation, and of these, 4 were periosteal and 3 were myeloid.

Dr. Coley said he thought the encapsulated tumors that had been described by Dr. Mathews should be taken out of the class of sarcomata.

Replying to the statement of Dr. Mathews that spindle-celled growths rarely affected the tibia, the speaker said that he had observed a number of such cases, and he had shown one such case at a meeting of the Association of the Greater City of New York in which the patient was well twelve years after curettage. He was strongly in favor of conservative measures in dealing with malignant growths of the long bones, and he had written a number of papers bearing upon that aspect of the subject. Many such cases could be cured by curettage and resection, and as an additional safeguard he believed in the use of the mixed toxins.

DR. MATHEWS, replying to Dr. Coley, said it was Sutton who made the statement that practically all medullary tumors were of this benign type and should be regarded as myeloma, and that spindle-celled sarcoma in the region was very rare. In regard to tumors originating in the marrow, the fact should be borne in mind that the marrow naturally had round cells, and that a round-celled tumor in that region might be quite benign, whereas if it were situated elsewhere it would be regarded as malignant. The speaker expressed the hope that the pathologists might learn more about the character of these growths, so that they could come to the aid of the surgeon. Thus far, the X-ray had proved of material aid in the diagnosis.

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ORIGINAL MEMOIRS.

TRANSFUSION BY CARREL'S END-TO-END SUTURE METHOD.

WITH REPORT OF CASES.

BY EUGENE H. POOL, M.D.,

AND

R. D. McCLURE, M.D.,

OF NEW YORK.

THE interest in direct transfusion of blood, aroused in the last few years chiefly by the work of Crile, has centred upon efforts to develop an easy and reliable method of forming the anastomosis. All of the numerous methods which have been advocated are really modifications of one of four procedures, namely: end-to-end suture—Carrel; approximation by apparatus—Crile, Elsberg, Soresi, Levin; vessel interlocking by end or lateral implantation—Hartwell; interposition of a foreign body link—Brewer, Frank.

A detailed discussion of these cannot be given here. Time and experience alone can prove which of the methods is the best. Careful reports of efforts at transfusion should be encouraged, so that sufficient wealth of material may accumulate to lead to definite conclusions.

Series of cases in which the various methods have been

employed are most instructive, and it is for this reason that we report twelve transfusions which have been made by the Carrel method of end-to-end suture. The therapeutic indications for transfusion likewise present a fertile field for physiological and surgical research, but we do not feel that our experience has been sufficient to warrant elaborate discussion of this phase of the subject.

The technic as initiated by Carrel is as follows: A donor free from advanced arteriosclerosis and giving no history or signs of syphilis is chosen. Hæmolytic and agglutination tests with the two bloods may be carried out if circumstances permit, but the necessity for and value of these tests are undecided.

A radial artery of the donor and a vein of the arm or leg of the recipient are the vessels of selection. One-half per cent. novocaine is used as the local anæsthetic. Adrenalin must not be combined with the novocaine on account of its constricting action on the vessels. In addition to the usual dissecting instruments, two small thumb forceps, several serrefine clamps of varying strength covered with rubber tubing to avoid injury to the vessel wall, fine Chinese silk, No. 16 Kirby needles, a rubber bulb with a small irrigating tip, and vaseline are required for the operation. The radial artery above the wrist is exposed. This dissection is facilitated by having the wrist extended over a sand bag. The deep fascia is exposed and opened upon a grooved director passed beneath it through a small hole. In freeing the artery a sharp knife is used so as to make a clean dissection, and contact of instruments with the vessel is avoided as it may stimulate contraction of the muscular coats. About three inches of the artery and from three to four inches of the vein are exposed and freed. After absolute hæmostasis is established, the branches of the vessels being ligated at some distance from the main trunks, the limbs of the donor and recipient are brought into juxtaposition and loosely bound together to prevent tension on the anastomosis by movements of the patients. Serrefine clamps of suitable strength are applied centrally on each vessel,

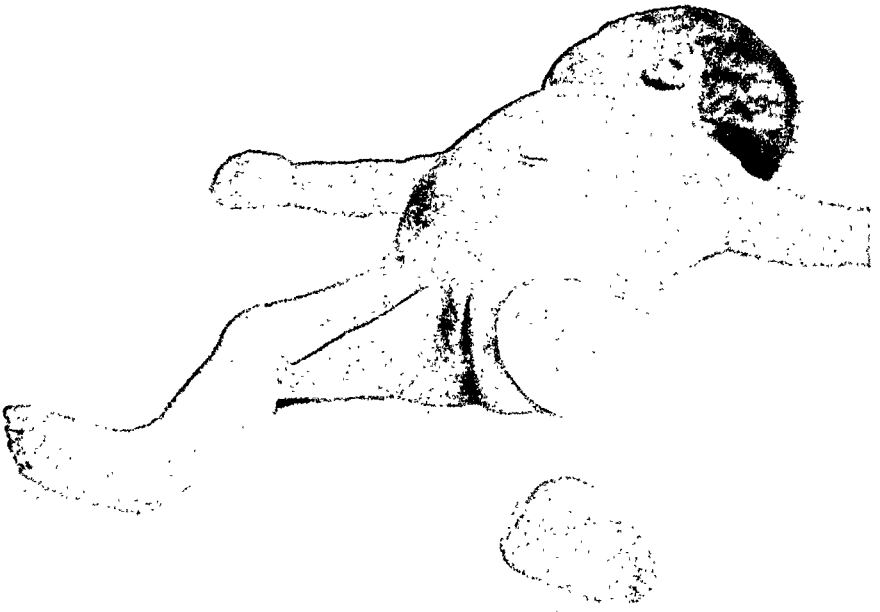
and ligatures distally. The vessels are cut across with sharp straight scissors about one-eighth of an inch from the ligatures. The blood is quickly stripped from them, after which they are washed clean with physiological salt solution by means of a fine glass tip with smooth end attached to a rubber bulb syringe. The entire wound, especially the cut ends of the vessels, is covered with vaseline. This prevents clotting on the injured intima if any blood should escape, and is an important step in the technic. The adventitial coat of each vessel is grasped between the thumb and forefinger, drawn over the vessel end, and severed with sharp scissors; it then retracts so that it cannot be included in the suture. To facilitate the handling of the white suture material, black silk towels cover the entire field with the exception of the ends of the vessels.

The ends are approximated and held together by three retention sutures of the finest Chinese silk, which divide the circumference into three equal parts. Each of these parts is successively put upon the stretch by traction on the retention sutures, and a continuous suture is thus easily run around the whole circumference, care being exercised that each stitch avoids the adventitia but includes the media and intima at a uniform distance from the cut edge. The intimæ of the two vessels are thus slightly everted and brought into contiguity. Three or four stitches are sufficient along each side of the triangle. The needle and thread of one of the retention sutures, preferably that tied last, is used for the entire circuit, a single knot being made with each retention suture as it is reached. After the completion of the suture, the anastomosis is gently surrounded by a small piece of hot moist gauze, the serrefines are removed, and the blood is allowed to flow from the donor into the patient. If there be any leakage it is usually quickly checked by the gauze. If a point bleeds persistently, as in two of our cases, a stitch may be added easily and effectively while compressing the artery between thumb and finger, when slight release of pressure demonstrates the site of the leak.

If the vessels have been roughly handled or have been seized by the dissecting forceps, small constriction nodes appear, which markedly retard the flow. These may disappear after the application of very warm salt solution.

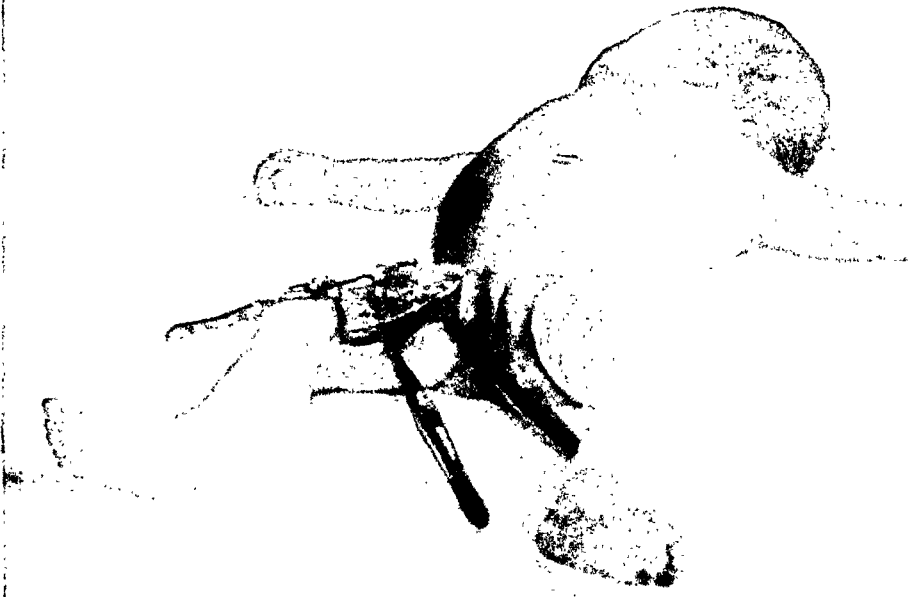
An argument in favor of the Carrel suture is that the anastomosis is not guarded by a rigid mechanical device, and can, therefore, be rolled and massaged with the rest of the exposed parts of the two vessels, if the flow appears too slow. Such stripping between the well-vaselined fingers has in our experience tended to keep the vessels dilated, thus permitting a full stream of blood. Another favorable feature of the Carrel method is that the calibre of the vessels is not diminished, and extreme dilatation at the site of the anastomosis is possible because the line of suture is on the stretch during the anastomosis. The strain is divided among many stitches, which, though frail in themselves, allow any reasonable amount of rough handling when combined. The absence of apparatus also prevents obscuring of the site of anastomosis so that any twisting of the vessels is at once apparent and can be easily corrected.

Although the median cephalic or median basilic veins may be used in adults, in infants and in children the saphenous or femoral veins are more favorable for transfusion. The position of the saphenous vein is definite, its length is sufficient, and there is no danger of injury to important structures or to the circulation of the limb; its calibre alone is questionable. In infants and young children it is too small. It seems wise, however, to examine it before exposing the femoral vein. The depth of the vein in the subcutaneous fat may cause some delay in locating it in the small subject, unless its anatomical position is definitely borne in mind. It can be readily exposed by abducting the thigh to about 65° and rotating it outward and making the incision in a line passing from slightly external to the spine of the pubes to the inner aspect of the popliteal space at the flexure of the knee. This lower limit corresponds to the posterior margin of the inner condyle of the femur. On cutting through the subcutaneous fat the



Incision for exposure of internal saphenous vein in thigh.

FIG. 2



Internal saphenous vein exposed.

vein is found close to the deep fascia (Figs. 1 and 2). In several of our adult patients we have used the saphenous vein near the ankle.

In one case where the median basilic vein was used, it was noticed that blood flowed far more freely from the cut end of the vein after the transfusion was finished (viz., three drachms in fifteen seconds), than could have been possible during the operation. There must, therefore, have been considerable resistance in the vein. This resistance can be diminished by elevating the limb of the donor, and in Transfusion VIII this was attempted. The saphenous vein was considerably larger than the artery, and subsequently the distal inch of the latter dilated to the size of the vein. The flow was so free that pulsation could always be felt and for the most part seen in the whole of the exposed vein. The donor lay on a high operating table; after the vessels had been exposed the recipient was placed on a stretcher at right angles to the donor with her feet on the table against his chest, her head being considerably lower so that she was inclined about 45° . With the donor's arm abducted 90° it brought the vessels together in a favorable position for the operation. The inclined position seemed to facilitate the flow by diminishing resistance in the veins. It must be borne in mind that in this position overdilatation of the heart is more likely to occur.

The physiological effect of the transfusion should be noted at frequent intervals by testing the hæmoglobin, pulse, and blood-pressure. The area of cardiac dulness should be frequently mapped out, and the stethoscope freely used to detect any inability of the heart to cope with the increase in the volume of blood. Finally, considerable information as to the mechanical success of the anastomosis can be obtained by testing the blood stream through the anastomosis at the completion of the transfusion by cutting the vein and measuring the flow before ligating the artery, or by severing a communicating venous branch during the transfusion. The blood, as a rule, spurts from this as though it were a branch of the artery itself.

During the past year we have used the Carrel method twelve times in ten patients, one patient being transfused three times. The cases were secondary anæmias with the exception of Case I, which was gas poisoning, and Case V, general septicæmia. The immediate results of the transfusions were good in all except Cases V and XII. In Case V the heart was not equal to the increased burden. In Case XII the hæmoglobin did not rise, although it was shown later that the lumen was satisfactory and there was no thrombosis; on the second attempt the anastomosis was partly obstructed by a small valve-like thrombus, and free hemorrhage from the ulcerated cirroid aneurism offset the benefit from the limited amount of blood which passed. Cases II, VII, X, and XI were in almost moribund condition and were markedly improved by the operation, apparently owing their lives to the transfusion. They are all now in good health.

CASE I.—*Illuminating gas poisoning. Hypostatic pneumonia.*

C. B., New York Hospital, Medical History No. 18007. Age 52. Houseworker. Admitted February 22. Died March 1, 1909. Service of Dr. Peabody.

The patient was found by the ambulance surgeon in a room in which illuminating gas was escaping. She was comatose. Pulse was rapid and extremely feeble. Respirations were four to six per minute when she was brought to the hospital.

Physical Examination.—Fairly well-nourished woman, apparently moribund. Pupils dilated and react only slightly to light. Well-marked slow nystagmus. Tongue swollen, congested, and purplish in color. Pharynx congested and contains frothy mucus. Radial pulse almost imperceptible. Neck not stiff. Heart: slightly enlarged, sounds very distant and weak, no murmurs. Lungs: breath sounds feeble, no dulness, and no râles.

Direct transfusion was decided upon. A female patient in the accident ward, who had just recovered from an attack of acute alcoholism, offered her blood and the operation was immediately performed. The left radial of the donor was anastomosed to the median cephalic vein of the right arm of the

recipient. The blood was allowed to flow for forty minutes, the vein pulsating all of the time. The patient showed the most marked improvement. Her respirations increased from 5 to 24 per minute. The pulse became full and of a good quality. She, however, did not regain consciousness. A phlebotomy was likewise performed, 34 ounces of blood being withdrawn.

During the ensuing week phlebotomy was done several times, and salt solution per rectum and hypodermic stimulation were given. The day after the transfusion the patient's hæmoglobin was 90 per cent., white blood-cells 26,000, polymorphonuclears 90 per cent. There was albumin in the urine.

The patient gradually developed a hypostatic pneumonia and died without regaining consciousness on the seventh day after admission. Her respirations varied during this time between 24 and 44, pulse rate between 76 and 120.

In regard to the treatment of illuminating gas poisoning by transfusion, the case shows that at least astonishing temporary effects may follow transfusion. The patient was resuscitated from a moribund condition, the respirations and heart action quickly became normal and remained so for several days. The red cells of the donor must have become carriers of oxygen. In this respect the clinical findings were similar to those obtained by Crile in experiments on dogs. If the degree of poisoning is such as to cause cerebral softening, permanent benefit cannot be expected.

CASE II.¹—*Secondary anæmia—hæmophilia?*

G. M., New York Hospital, Medical History No. 18851. Age two years, 11 months. American. Service of Dr. Conner. Transferred to service of Dr. P. R. Bolton.

Family History.—No history of tuberculosis, neoplasm, syphilis, nor hæmophilia in the family of either parent. There is one older and one younger child, neither of whom has shown the slightest tendency to bleed easily.

Past History.—The patient is the second child; normal, uneventful delivery. Walked at nine months. Has had none of the diseases of childhood. While teething she had slight intestinal trouble but quickly recovered. When two years old

¹ Presented before the Surgical Section of The New York Academy of Medicine, April 1, 1910.

it was noticed that the slightest bruise left an extensive area of discoloration. Five months ago she began to have nose-bleed, which sometimes occurred in her sleep. Four months ago she fell, lacerating the upper part of her scalp. Wound was sutured by an ambulance surgeon. That night the wound began to bleed profusely, and she was taken to the House of Relief where the hemorrhage was controlled by deep sutures. The entire upper part of her face became ecchymotic.

Several severe attacks of epistaxis occurred during the following month which were controlled only after great loss of blood. She was readmitted to the House of Relief August 5, with epistaxis and weakness. August 8, red blood-cells 2,300,000, white blood-cells 18,200, polymorphonuclears 44 per cent., small mononuclears 40 per cent., transitionals and large mononuclears 16 per cent., hæmoglobin 30 per cent.

August 12: She was infused with 100 c.c. of artificial serum. This was followed by a severe chill and by a rise in temperature to 105.2°. The epistaxis which had been almost continuous was checked.

August 14: Red blood-cells 2,180,000, white blood-cells 16,500, polymorphonuclears 26 per cent., small mononuclears 71 per cent., transitionals 2 per cent., large mononuclears 1 per cent., hæmoglobin 25 per cent. No more epistaxis while in hospital. Temperature ranged between 98° and 100°. Urine was normal.

She was transferred to New York Hospital and from there to a Convalescent Home.

October 2: She was brought back to New York Hospital with persistent epistaxis. Physical examination negative excepting for epistaxis, rapid pulse, and ecchymotic spots scattered over the body. Urine negative. Nares were packed with gauze saturated with adrenalin solution, but bleeding was not controlled.

October 4: Red blood-cells 2,300,000, polymorphonuclears 63 per cent., large mononuclears 10 per cent., small mononuclears 16 per cent., transitionals 16 per cent., eosinophiles 3 per cent., basophiles 1 per cent., hæmoglobin 14 per cent., slight polychromatophilia and poikilocytosis. She was infused with 200 c.c. of artificial serum. No further bleeding for 32 hours, when she began to have profuse uncontrollable hemorrhage from the nose which almost exsanguinated her.

October 5: Transfused. Radial artery of the father was sutured to the saphenous vein of the child by the Carrel end-to-end method of anastomosis. Blood began to flow immediately but there was no visible effect on the child for 12 minutes, after which the capillaries in the conjunctivæ and ears became visible, and soon there came a tinge of pink in the child's lips and her hands became warm. At the end of 55 minutes the transfusion was stopped, the child was rosy and warm, lips red, pulse 160 and of good quality. Slight epistaxis of dark red blood began but soon ceased. Hæmoglobin readings taken every 10 minutes showed a steady rise from 14 per cent. to 68 per cent. The general condition of the patient greatly improved. The next day the hæmoglobin was 95 per cent.

Recovery was uneventful excepting for a slight bronchopneumonia of short duration and some epistaxis and vaginal bleeding. Very slight bleeding occurred twice during the following week, and once a petechial rash appeared on the face after the child strained at stool.

Discharged October 29. Cured. Hæmoglobin 89 per cent.

January 28, 1910: Patient was brought to the hospital. She had just recovered from chicken-pox of the hemorrhagic type. Small black and blue marks were present over the whole body. She had had several hemorrhages, but her condition and color were excellent.

CASE III.—*Secondary anæmia. Carcinoma of stomach(?)*.

M. Q., History Number 3409, age 41, single, housekeeper. Admitted to French Hospital, July 23, 1909. Discharged Aug. 12, 1909.

Chief complaint, pain in epigastrium, vomiting, and general weakness.

One year ago the patient began to vomit about ten minutes after taking food. The vomiting was preceded by slight nausea and was not accompanied by pain. It continued for about six months and was independent of the character of the food taken. She lost considerable flesh and became weak. She never vomited blood. For the last six months she has had pain in the epigastrium, especially after eating. The patient enjoyed good health until the present illness.

On admission the woman appeared markedly emaciated, the skin and mucous membranes were very pale. Nothing noteworthy

was found on further physical examination. Gastric analysis: quantity extracted one hour after Ewald test meal 30 c.c.; color light tan; large amount of mucus; no free blood. Free acid, none, lactic acid, moderate amount.

White blood-cells 11,000, polymorphonuclears 65 per cent., small lymphocytes 11 per cent., large lymphocytes 16 per cent., basophiles 2 per cent., eosinophiles 6 per cent., hæmoglobin 30 per cent., red blood-cells 2,210,000.

Carcinoma of the stomach was suspected. Since obstructive symptoms were not prominent, as she had ceased vomiting, it seemed wise to do an exploratory laparotomy only if her condition could be improved sufficiently to warrant a resection if this should prove indicated. On August 6, 1909, the patient was transfused. Considerable improvement resulted, but the patient decided to defer operation.

Anastomosis completed and transfusion begun at 1.15 P.M., August 6, and was terminated at 2.10 P.M. Hæmoglobin rose from 30 to 44 per cent.

After transfusion August 6 (7 P.M.), red blood-cells 3,800,000; hæmoglobin 40 per cent.

Aug. 7 (10 A.M.) red blood-cells 4,000,000; hæmoglobin 50%

Aug. 7 (7 P.M.) red blood-cells 4,400,000; hæmoglobin 55%

Aug. 9 (10 A.M.) red blood-cells 4,600,000; hæmoglobin 45%

The patient left the hospital and was told to report for examination later which she failed to do. On March 25, she died at home. No autopsy. It is said by the family physician that for four months she was in fair condition; that during the last three and a half months she failed rapidly, vomited constantly, and had severe epigastric pains.

CASE IV.—*Secondary anæmia, biliary fistula, multiple hemorrhages, senility.*

P. F., French Hospital, History Number 3546, French, age 80, admitted September 21, 1909. Died October 14, 1909.

Chief complaint, swelling and pain in inner part of the left thigh.

History.—Seven days ago patient noticed a swelling in the above mentioned region, which gradually increased. There is severe pain at site of swelling, radiating from femoral region to the knee. He is unable to stand. There is no history of

trauma. Appetite good, bowels regular, urinates three to four times daily and two or three times at night. Two days ago he says he vomited a cupful of blood.

Never had similar trouble before. Two years ago patient was operated upon for gall-stones, and the wound never closed. Has had a right inguinal hernia for 30 years. Denies urethritis and syphilis.

Physical Examination.—The scrotum, penis, and inner and posterior surface of the left thigh to the knee are ecchymotic. There is a globular swelling below Poupart's ligament on the left thigh about three inches in diameter. It is tense and tender on pressure, flat on percussion, and has no bruit. Over most of the ecchymotic area there is induration which does not pit on pressure.

The man is thin and anæmic; the arterial walls are thickened. There are a few crepitant râles and dulness at right apex in front. In the scar of gall-bladder operation there is a fistula discharging bile very freely. Just above Poupart's ligament on the left side there is a small reducible inguinal hernia. He is unable to move his left leg.

On September 23, 1909, an incision was made over the swelling on inner part of thigh; it proved to be a hæmatoma. Blood oozed intermittently from the wound. Horse serum was administered subcutaneously on three successive days without effect. There was no fever at any time; cultures of fluid from hæmatoma were sterile. Blood examination October 11, hæmoglobin 18 per cent., red blood-cells 1,856,000, blood-pressure 94 mm.

The patient was transfused on October 12, 1909; anastomosis completed and flow begun at 11.47 A.M.; flow discontinued at 12.50 P.M. Hæmoglobin rose from 18 per cent. to 39 per cent.

After transfusion: October 12 (7 P.M.) hæmoglobin 48 per cent., red blood-cells 2,380,000, blood-pressure 112 mm.

October 13 (10 A.M.) hæmoglobin 50 per cent., red blood-cells 2,900,000, blood-pressure 110 mm.

October 14, the patient had a profuse rectal hemorrhage, and died soon afterwards. No autopsy.

CASE V.—*Septic endocarditis. Septicæmia.*

A. R., New York Hospital, Medical History No. 18344.

Age 22. Milliner. Austrian. Admitted March 13, 1909. Service of Drs. Conner and Lambert. Died September 30, 1909.

Past History.—Has had no previous acute illness. No history of joint symptoms, nor sore throat. When ten years old a swelling in her neck was first noticed and she thinks that it has not grown larger since then. Thinks eyes have never been bulging; she has been nervous and excitable, and frequently has had palpitation of the heart.

Uses beer and wine moderately. Usually constipated.

No history of syphilis or gonorrhoea.

Present illness began two months ago with headache, and sharp pains in legs but not in the joints. This was soon followed by anorexia, nausea, and sharp pain over the whole abdomen which came on immediately after eating and lasted from one to two hours. At times swallowing was difficult, and she vomited sour smelling fluid which had never to her knowledge contained blood. Has had occasional sticking pains over her heart and for some time constant severe pain in the left side of abdomen.

Recently has had chilly feelings and night-sweats. No cough nor difficulty in breathing. No urinary symptoms, swelling of feet, or ankles. Has not been jaundiced. Complains of feeling very tired and weak.

Physical Examination.—Fairly well-nourished girl. Skin and mucous membranes good color. Eyes normal. Tongue moist, coated. Pharynx normal. Neck not stiff. Slight enlargement of the thyroid but no thrill nor bruit present. Diastolic pulsation is present in large veins. Systolic murmur in carotids. Pulses equal, regular, good size and force, moderate tension, Corrigan in type. Vessels not sclerosed. Capillary pulse in nails. Heart is enlarged, gallop rhythm, prolonged rather rough diastolic murmur over aortic area. Second pulmonic accentuated. No thrills felt. Lungs normal. Abdomen soft, not tympanitic. No masses. Liver tender on percussion, normal in size. Spleen not enlarged. Kidneys not palpated. Extremities, knee-jerks greatly diminished. No œdema. No enlargement of the superficial lymph-nodes. Temperature 101.8°, respirations 24, pulse 120. Urine examination shows absence of sugar and albumin. Hæmoglobin 66 per cent., leucocytes 9000, polymorphonuclears 79 per cent., lymphocytes 21 per cent.

Blood culture taken on May 18 showed a pure culture of streptococcus. On the third day after admission she developed a systolic murmur at the apex, and on the fifth day petechial spots appeared on the front and back of chest. Abdomen became very tender and rigid. May 22 she began to receive a vaccine made from the organism obtained from her blood.

In spite of all treatment with different varieties of homologous vaccines and the usual therapeutic measures, the disease ran its course with typical waves of improvement alternating with periods of exacerbation, the up-and-down septic temperature, enlarged spleen, nephritis, petechiæ, etc.

Her brother, a healthy young man, consented to be the donor for a transfusion. He was prepared by vaccination with the vaccine made by Dr. Elser, pathologist to the New York Hospital, from the streptococcus of her blood, the purpose being to produce antibodies in his blood antagonistic to that organism.

September 11, 1909. Transfusion. Service of Dr. Bolton. Several ounces of blood were first drawn from the patient's veins. The radial artery of the donor was then sutured to the left internal saphenous vein of the recipient. The anastomosis was perfect; blood flowed freely and apparently at a good volume. After ten minutes the patient became restless, irrational, cyanosed, her pulse rapid and irregular, and respirations rapid and almost stertorous. It seemed extremely dangerous to continue, so the transfusion was immediately stopped. She was stimulated by hypodermic injections and in a few hours she had recovered fairly well.

During the next week the patient developed general œdema. Showers of emboli, causing pain in the internal organs, and petechiæ continued, and the patient's asthenia became marked. She died on the nineteenth day after transfusion, after an illness of almost eight months. No autopsy.

CASE VI.—*Secondary anæmia following puerperal septicæmia.*

V. M., French Hospital, History Number 3665, married, age 30, Italian, housewife. Admitted October 22, 1909, discharged December 3, 1909.

For the last seven weeks, patient has complained of pain in left side of abdomen and back, pain is severe in character and radiates over lower part of abdomen. Urinates somewhat too

frequently, bowels irregular, appetite poor. She has lost considerable weight and feels very weak.

Was operated upon elsewhere, on August 31, 1909, for "puerperal septicæmia." The operator sends the following details: "Temperature 105°, pulse 130, respirations 30 before the operation. There was a large intramural abscess on the left side, extending into broad ligament and including left tube and ovary. The sigmoid was included in adhesions and slightly eroded. Patient's condition permitted only a rapid laparotomy and drainage. Fecal fistula appeared on fourth day. After operation and for some days subsequently, the pulse ran from 136 to 128. Temperature 104° to 100° and respirations 60 to 30."

Physical Examination.—Patient is very feeble, pale, and emaciated. Heart negative. There are a few sibilant râles at the right apex. Abdomen: There is a wound about three inches long in the left lower quadrant of the abdomen discharging pus and fæces. The entire abdomen is tender to palpation, especially on the left side where a mass is indefinitely felt. By vagina extensive induration is appreciable in the left side of pelvis. There is a profuse purulent vaginal discharge.

Urine: Turbid, flocculent precipitate, specific gravity 1026, acid, albumin present, considerable pus and amorphous urates. Blood examination on October 24, hæmoglobin 30 per cent.; red blood-cells 2,384,000; white blood-cells 8500; polymorphonuclears 74 per cent.; small lymphocytes 20 per cent.; large lymphocytes 3 per cent.; basophiles 2 per cent.; eosinophiles: 1 per cent.

The patient's condition was so poor that a transfusion was done in the hope of making her better able to stand an operation. Improvement was marked and operation was repeatedly deferred.

Transfusion, October 25, 1909. Anastomosis completed and flow begun at 11.07 A.M.; flow discontinued at 11.58 A.M.

Blood-pressure (systolic)	Time	Recipient
	10.00 A.M.	110 mm.
	11.20 A.M.	124 mm.
	11.40 A.M.	115 mm.*
	12.00 M.	150 mm.

* At this sudden fall in blood-pressure apex of heart had moved $\frac{1}{2}$ inch to left; volume of flow was diminished for five minutes and heart gradually resumed its normal outlines.

	Time	Recipient
Pulse.....	10.00 A.M.	108
	10.30 A.M.	104
	11.00 A.M.	96
	11.30 A.M.	92
	12.00 M.	84
	12.15 P.M.	88
Hæmoglobin.....	10.00 A.M.	34 per cent.
	11.15 A.M.	45 per cent.
	11.40 A.M.	47 per cent.
	12.00 M.	50 per cent.
	12.15 P.M.	50 per cent.

After cutting vein, three drachms of blood flowed in fifteen seconds.

Oct. 25 (8 P.M.): Hæmoglobin 54 per cent.; red blood-cells 3,608,000; blood-pressure 119 mm. Improvement continued steadily until Nov. 1, when hæmoglobin was 62 per cent.; red blood-cells 4,600,000; from the 1st to the 20th there was a steady fall; November 20, hæmoglobin 42 per cent.; red blood-cells 3,300,000. No operation was performed, and at the time of her discharge the fecal fistula was almost closed, the pelvic and abdominal masses had greatly diminished, and her general condition was so good that she was able to return at once to her household duties.

TRANSFUSIONS VII, VIII, and IX.³—*Anæmia* (transfused three times).

M. T., French Hospital, Admission Number 15,399, age 43, French, married, housewife. Admitted December 29, 1909.

Present History.—Onset, 14 days ago, began with violent headache, pain in back, over heart, and in epigastrium, and extreme weakness; a day later slight jaundice appeared; she has been confined to bed since onset.

Previous History.—In 1896 patient had menorrhagia for which she was curetted; in 1900 she was operated upon for an abscess on the left side of thorax; in 1902 she had rheumatism which confined her to bed one month. She has had at times a distressing cough and dyspnoea for a number of

³ Presented before the New York Surgical Society, May, 1910. We are indebted to Dr. Shanley, house surgeon of the French Hospital, for the records of the cases at that institution.

years, also palpitation on the slightest exertion, but no night-sweats, chills, or fever; she has had œdema of legs for nine years, gradually increasing to date; also frontal headaches, worse at night and throbbing in character, spots before the eyes, vertigo, and tinnitus for the past three or four years. Gives no history pointing either to gonorrhœa or syphilis. For past two years patient has been under severe mental strain. Eighteen months ago she began to lose her color, the pallor has gradually increased. Menses began at fourteen years and were regular until 25 years of age, since then they have been profuse much of the time, lasting five to eight days, and making her very weak for some time following. The menorrhagia has been especially marked recently. Married at twenty-five; two children living and well; no miscarriages. Habits good.

Physical Examination on Admission.—Woman of medium size, apathetic, and aroused with difficulty. Face expressionless, mucous membranes colorless, lips dry, parched, and brown, conjunctivæ slightly yellow, skin has a lemon tint and is bloodless, superficial veins show conspicuously as dark blue lines. Radial pulse not palpable, heart sounds very feeble. The woman appears moribund. Blood examination shows 600,000 red blood-cells and 16 per cent. hæmoglobin. Urine, December 29, 1909: turbid, amber, flocculent precipitate, specific gravity 1016, acid, no sugar, moderate amount of albumin, numerous epithelial and red blood-cells, few white blood-cells, many hyaline and granular casts.

Transfusion was immediately done, taking the husband as donor, although he was weak and anæmic. There was moderate improvement. The next day a second transfusion was made, taking a young man as donor. Marked improvement resulted. Cheeks became flushed, lips of a normal color. The recipient, however, became extremely restless and it was necessary to stop. Afterwards she became delirious and two days later showed extreme jaundice.

The third transfusion was done ten days later, as the patient's blood and general condition had begun to show a marked change for the worse. A healthy young man was used as the donor. Considerable and prolonged improvement resulted.

Record of first transfusion, December 29, 1909:

Before transfusion, red blood-cells 600,000, hæmoglobin 16 per cent., blood-pressure 100 mm.

Flow begun at 1.21 P.M., discontinued at 2.15 P.M.

		Donor	Recipient
Blood-pressure.....	{ Beginning..	130	99
	{ End.....	119	128
Pulse.....	{ Beginning..	88	128
	{ End.....	92	122
Hæmoglobin.....	{ Beginning..	71 per ct.	16 per ct.
	{ End.....	57 per ct.	22 per ct.
Red blood-cells.....	{ Beginning..	3,600,000	600,000
	{ End.....	2,700,000	928,000

December 29, 7 P.M.: Red blood-cells 1,008,000, hæmoglobin 21 per cent., white blood-cells 42,000, polymorphonuclears 69 per cent., small lymphocytes 16 per cent., large lymphocytes 13 per cent., basophiles 2 per cent., megaloblasts 5 per cent., normoblasts 7 per cent., marked poikilocytosis, numerous umbilicated red cells. Stools negative for ova, occult blood, etc.

Second transfusion, December 30, 1909. Transfusion flow begun at 5.03 P.M., discontinued at 6.11 P.M.

After transfusion vein was cut and in 14 seconds there flowed 110 minims.

		Donor	Recipient
Blood-pressure.....	{ Beginning..	128	111
	{ End.....	100	136
Pulse.....	{ Beginning..	82	120
	{ End.....	124	104
Hæmoglobin.....	{ Beginning..	81 per ct.	19 per ct.
	{ End.....	65 per ct.	33 per ct.
Red blood-cells.....	{ Beginning..	4,100,000	1,015,000
	{ End.....	3,018,000	1,952,000

Subsequent to transfusion: December 31, 7 P.M.: Red blood-cells 2,288,000, hæmoglobin 35 per cent., white blood-cells 18,700, polymorphonuclears 72 per cent., small lymphocytes 8 per cent., basophiles 1 per cent., normoblasts 6 per cent., megaloblasts 3 per cent., marked poikilocytosis and numerous umbilicated red cells.

January 9: Red blood-cells 1,236,000, hæmoglobin 25 per

cent., white blood-cells 11,900; otherwise the counts taken each day were about the same as that last given.

Third transfusion, January 10, 1910. Flow begun at 6.16 P.M., stopped at 6.55 P.M.

	Donor	Recipient
Blood-pressure.....	{ Beginning.. 120	92
	{ End..... 102	125
Pulse.....	{ Beginning.. 72	136
	{ End..... 92	120
Hæmoglobin.....	{ Beginning.. 100 per ct.	23 per ct.
	{ End..... 94 per ct.	56 per ct.
Red blood-cells.....	{ Beginning.. 5,150,000	1,184,000
	{ End..... 3,746,000	1,386,000

After this the patient did fairly well, although she developed a pneumonia in lower right base and later pleurisy with effusion on left side. This made necessary repeated tapplings (10 in all), at times 20-30 ounces of clear or blood-tinged fluid being removed.

March 5: Von Pirquet test negative.

March 13: Patient has been up for some days, can walk, has fair appetite, and feels well. Urine occasionally shows trace of albumin. Red blood-cells 2,624,000, hæmoglobin 70 per cent.; the blood is otherwise normal.

May 7: Patient in good condition, hæmoglobin 70 per cent.; red blood-cells 3,150,000.⁴

CASE X.—*Papilloma of bladder. Excision. Secondary anæmia.*

J. S., the Post-Graduate Hospital, service of the late Dr. Follen Cabot. Male, age 34 years. Admitted January 20, 1910.

Chief complaint, pain in left side of abdomen and bloody urine.

⁴The cause of the anæmia in this case could not be definitely determined.

Dr. N. B. Potter, who supervised the treatment much of the time, wrote, "Her blood picture has not been one of typical pernicious anæmia; how much, however, it has been altered by the transfusions no one can say. Very grave anæmia with a persistently high color index is as near as I can get."

Dr. F. C. Wood wrote, "I would not like to make a positive diagnosis of pernicious anæmia on the smears, but would prefer to call the condition a secondary anæmia."

Past History.—Has had several previous attacks of hæmaturia, otherwise the history is unimportant.

Present Illness.—Blood appeared in the urine nine days ago and has been steadily increasing in amount since. There has been pain in the left lumbar region and in the end of the penis during urination. Patient has had great difficulty in urinating during the past three days.

Physical Examination.—Patient is a large, well-nourished Italian, showing nothing abnormal on external examination excepting extreme pallor. Specimen of urine contains almost pure blood.

Operation by Dr. Cabot, January 21. Suprapubic cystotomy. Excision of papilloma of the bladder. Rubber drainage tube left in the bladder. Operation begun with eucaine local anæsthesia and completed under nitrous oxide gas anæsthesia. Duration, one hour. General condition of patient very poor. Pulse weak and rapid after the operation.

Five and a half hours after the operation the patient was comatose and practically moribund. Hæmoglobin 34 per cent., red blood-cells 1,500,000, pulse 156 per minute.

Transfusion was performed by one of us (R. D. McC.) with the assistance of Dr. Aspinwall Judd. The donor was a brother and of only about two-thirds the stature of the patient. The right radial artery of the donor was anastomosed to the left internal saphenous of the recipient. The vessels were exposed and anastomosed in 28 minutes. The blood was allowed to flow 40 minutes.

The following table was made during the operation. At 5.30 P.M. flow of blood started.

	Hæmoglobin	Pulse
5.40 P.M.	36 per cent.	132
5.45 P.M.	42 per cent.	126
5.50 P.M.	53 per cent.	126
5.55 P.M.	54 per cent.	126
6.00 P.M.	58 per cent.	126
6.05 P.M.	62 per cent.	125
6.10 P.M.	62 per cent.	125

Transfusion ended, 6.10 P.M.

The patient's general condition and color underwent marked improvement during the transfusion. The transfusion would have been continued but the donor began to show the effect of

the loss of blood. He became very pale, restless, and nauseated. Eight P.M., the same day, hæmoglobin 64 per cent., pulse 140.

January 22, 10 A.M.: Red blood-cells, 3,320,000, hæmoglobin 76 per cent. General condition is greatly improved and patient is mentally much brighter.

January 26: Red blood-cells 3,170,000, hæmoglobin 71 per cent.

February 11: Red blood-cells 3,616,000, hæmoglobin 75 per cent (Talquist).

All of the previous readings had been taken with the Dare hæmoglobinometer. March 3d. Red blood-cells 4,112,000, hæmoglobin 75 per cent. (Talquist). The condition of the patient is good and he is ready to leave the hospital.

CASE XI.³—*Infected fibroid of uterus. Suppurative metritis. Multiple metastatic abscesses of thigh. Pyæmia.*

New York Hospital, service of Dr. Bolton. Surgical History No. 38,247, Mrs. J., 35 years, admitted August 3, discharged November 4, 1909.

Past History.—Has always been strong and healthy. Menstruation began at seventeen years of age, regular, every five weeks, not painful. Married at twenty-one. First three pregnancies terminated successfully.

Present Illness.—On July 7 patient had a miscarriage and stated that it was not induced. Her last period had been in May. Following the miscarriage she had persistent bleeding and the discharge soon became very foul. She had chills and a high fever. She became so ill that she did not remember much about the early part of her sickness. Her physician gave her intra-uterine douches. Bleeding soon stopped, but she continued in a very serious condition and was brought to the hospital.

Physical Examination.—Patient is an extremely anæmic woman. She is weak and appears septic. Head: face and mucous membranes are almost bloodless. Tongue is slightly coated, teeth are very bad. Heart percusses normal. Sounds are distant and weak and there is a systolic murmur at apex, transmitted toward axilla, not well heard in back. Lungs:

³ Presented before the Surgical Section of The New York Academy of Medicine, April 1, 1910.

normal. Abdomen: not distended or tender. Just above the symphysis and to the right of midline, there is a slight rounded prominence. On palpation it is found to be firm and freely movable. There is a slight resistance above the limit of this mass.

Vaginal Examination.—Outlet normal for multipara. Marked discharge of pus. The cervix is large and soft. The external os is dilated and emits a profuse discharge of pus. Bimanual examination reveals a large, firm, elastic, fairly movable mass without fluctuation extending upward from the right side of the uterus. Tubes and ovaries are indefinitely palpable.

Temperature 102°, pulse 124, respiration 28. Hæmoglobin 30 per cent., leucocytes 40,000, polymorphonuclears 84 per cent., mononuclears 13 per cent., transitionals 3 per cent. The red cells show considerable poikilocytosis. No nucleated reds found.

The general condition of the patient was such that it was thought she could not stand an operation. She did not improve under treatment but became weaker. October 9 her white blood-cells numbered 16,000, and her temperature reached 104.8°.

A brother willing to give his blood offered himself and a transfusion was decided upon. Patient's hæmoglobin was now 18 per cent.

August 10: Transfusion was unsuccessfully attempted by others by Hartwell's implantation method, with a Crile cannula and by suture. Clotting occurred in the first two attempts, considerable hemorrhage in the last, which was not controlled until a clot had formed.

August 11: Transfusion was performed following Carrel's technic of end-to-end blood-vessel suture. The right radial of the donor and the right internal saphenous vein of the patient were prepared under local novocaine anæsthesia. Anastomosis was easily made. There was slight bleeding at the line of union, but this quickly stopped without further suture. Pulsations were palpable in the vein. The calibre of the vein remained small for about fifteen minutes, when the vessel began slowly to dilate and the blood flowed more freely. The hæmoglobin rose gradually but with a marked acceleration toward the end of the operation, from 18 to 40 per cent. The transfusion was stopped when the donor became restless and vomited several times. The patient's mental condition had improved.

Her lips at the beginning were colorless, but were now red and her cheeks had gained a healthy pink.

The anastomosis was opened and found perfectly patent. No thrombosis. The afternoon of the transfusion a dull curet-tage was done and some tissue and considerable pus were brought away. Uterine irrigation given. The pathologist reported the specimen to be well-preserved muscle tissue. For a few days the condition of the patient was excellent, but soon she became weaker and her hæmoglobin dropped within six days to 18 per cent., the same as before transfusion. Spectroscopic examination failed to reveal a trace of bile or blood pigments in urine. On August 15 her general condition was about the same as before transfusion. The mass in the lower abdomen was markedly diminished in size, and there was an absence of tenderness and rigidity in lower abdomen. White blood count, 24,000, polymorphonuclears 84 per cent., red blood-cells 1,800,000, temperature ranged around 101°. Transfusion wounds healed.

The following abstracts from the bedside notes outline the subsequent course.

August 17: General condition is very much improved. She takes food by mouth and retains nutrient enemata. She feels much stronger. Discharge from vagina remains profuse with extremely unpleasant odor. Small necrotic mass expelled from uterus. Uterine tumor much decreased in size.

August 29: Very slight uterine discharge. Uterus is now small, fairly firm, and movable. Mass is no longer felt in its wall. Cervix normal. Hæmoglobin is rapidly rising. Yesterday she had two chills, followed by elevation of temperature to 105°, accompanied by severe nausea and vomiting.

September 12: Hæmoglobin 50 per cent. Patient feels stronger and looks better, though she has had numerous chills with sudden rises and falls of temperature during the last few days.

September 29: Pain has persisted in the right thigh and calf. There is slight swelling with some fluctuation and increased surface temperature on inner side of right thigh just above the knees. She has been having chills and considerable fever.

September 30: Incision made over inner side of right thigh and a considerable quantity of pus evacuated. Drainage.

October 8: A few petechiæ have appeared on chest, arms, and back. Daily rise of temperature and frequent chills persist. The petechiæ followed an attack yesterday in which she complained of a peculiar sensation over entire body, and pain in back which lasted about six minutes. Over bases of both lungs are subcrepitant râles and a few râles are present anteriorly. No pain over spleen or kidney regions. Patient vomits frequently and vomitus contains bile. Sinus is discharging freely. Pathologist reports original culture from thigh sterile. Hæmoglobin has gone down to 45 per cent. Blood cultures continue negative.

October 15: Temperature has been normal for two days, and she feels much better and is taking more food. Sinus is healing slowly. She is now receiving dead staphylococci injections with no local or general reaction.

October 23: Gaining in strength daily. Has had no rise of temperature for five days. Is now taking food of from 1800 to 2200 calories value daily as advised by Dr. Conner.

October 31: Is now able to walk with assistance. Hæmoglobin 53 per cent.

November 4: General condition good. No pain, fever, or chills. Is gaining in weight and is able to walk alone. Pelvic examination negative. Uterus normal in size and there is no discharge. No tenderness on palpation. Wound in thigh is practically healed.

Diagnosis: Infected myoma of uterus, suppurative metritis. Metastatic abscess of thigh, septicæmia? Result: Cured. Patient discharged to go to the country.

Patient seen in December, is in perfect health. Has gained in weight even to excess. Color is that of a robust healthy woman.

CASE XII.—*Secondary anæmia, following hemorrhage from cirroid aneurism of face.*

I. G., New York Hospital. Surgical History No. 39,607. American girl, age 22. Admitted February 18, 1910. Service of Dr. Hartley.

Patient was born with a large vascular nævus over the left side of face, involving also the left ear which has always been larger than the right. The nævus grew and greatly disfigured the face and ear. Five years ago both carotid arteries were

ligated. Since then the mass has steadily increased in size, though more rapidly during the past two years. Eighteen months ago the ear became ulcerated, and foul-smelling pus has been continually discharged. Several severe hemorrhages have been checked with the greatest difficulty.

She is now suffering from pain, loss of appetite, loss of weight, nervousness, and anæmia.

Physical Examination.—Rather large girl with marked anæmia. There is a large pulsating tumor involving the left side of the face, scalp, and ear, which is about five times the natural size and much distorted. Immediately under the skin the tortuous outlines of large vessels are plainly visible. The lower half of the growth is ulcerated and emits a foul odor. The auditory canal is obliterated, and the sense of hearing is absent on this side. A loud systolic murmur is heard over the entire surface of the growth.

After admission to the hospital several hemorrhages occurred which were checked only by tight bandaging. Anæmia became marked and weakness extreme. Hæmoglobin readings fluctuated between 19 and 40 per cent.

On February 21 transfusion was performed. The donor was a highly neurotic sister who so excited the patient during the operation that an almost fatal hemorrhage occurred. The radial artery was first anastomosed to the saphenous vein near the ankle. As the flow was not satisfactory, a second anastomosis was made with the cephalic vein.

The transfusion resulted in little benefit, the hæmoglobin at the end reading only a few points higher than at the beginning. The loss of blood during the transfusion as the result of hemorrhage from the ulcer was very free, therefore it is likely that the hæmoglobin readings were not a true index of the amount of blood which passed.

The patient was discharged from the hospital March 29 unimproved.

BLOOD TRANSFUSION IN HÆMOPHILIA.*

BY CHARLES GOODMAN. M.D.,

OF NEW YORK,

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THE following case is reported as an evidence of the importance of blood transfusion in the treatment of hæmophilia.

The patient in question, a male, is two and one-half years of age, and is the third of four children, two of whom are females. He was admitted to the Beth Israel Hospital on July 10, 1909, twenty-four hours after having fallen from a fire-escape to the landing below. The child had sustained a lacerated wound of the right cheek, which was surrounded by a hæmatoma involving the entire right side of the face and extending to the lower eyelid. The buccal mucous membrane was lacerated in several places, and the upper lip completely severed. The latter had been sutured before admission to the hospital. Blood was oozing from all the wounds of the mouth and cheek.

A further examination of the child revealed the fact that the surface of the body was almost completely covered anteriorly and posteriorly with ecchymotic spots, varying in size from a ten-cent piece to a half dollar.

The patient was a fairly well-developed child for its age, but was exceedingly pale and appeared to have lost considerable blood. Upon inquiry into the history, the mother volunteered the following information:

"The child almost from birth showed a tendency to develop black and blue spots on the body upon the slightest injury. These spots often appeared after mere contact with some hard object, and would last from six to eight weeks. Ritual circumcision, performed on the eighth day after birth, was followed by continuous bleeding for several days. This was finally checked after several physicians had been called in, but not until the child was so ex-

* Patient presented before the Surgical Section of the New York Academy of Medicine, at the stated meeting held Nov. 5, 1909.

sanguinated that its life was despaired of. One year ago the child cut its finger and the wound bled for two weeks. About eight months ago the child fell and cut its gums, and this wound continued to ooze for several months."

Neither a history of consanguineous tie in the family nor that of hemorrhagic diathesis could be elicited.

The temperature of the child upon admission was 98.4° , pulse 150, urine was negative. During the first two days, the following measures were used to check the bleeding: application of adrenalin chloride, nitrate of silver, ice, and pressure with pledgets of gauze. Calcium chloride was administered by mouth, also tr. ferri chloridi. These were followed by calcium lactate and saline solution per rectum, and saline hypodermoclysis. On the morning of the second day 20 c.c. of diphtheria antitoxin were administered in two doses hypodermatically.

During the first day in the hospital the child vomited several times, bringing up several ounces of blood. On the following day he had several blood-stained movements.

In spite of all the measures used, the oozing continued, and although the loss of blood at times seemed insignificant, the child appeared to be getting weaker and weaker, as the pallor of the skin and mucous membrane became progressively more marked.

The transfusion of healthy blood was considered, and a donor sought for. The mother volunteered, but being at that time in her eighth month of pregnancy, and in view of the possibility of her having been responsible for the peculiar dyscrasia in the patient, was rejected. The father likewise was not considered, as he was poorly nourished, delicate, and anæmic, and could not have stood the loss of blood. A donor was readily obtained in a healthy applicant, nineteen years of age.

While Dr. J. J. Hertz, of the bacteriological department of the hospital, made the preliminary hæmolytic and the Wasserman and Noguchi tests, 5 c.c. of fresh serum obtained from a live rabbit was injected.

For a few hours the oozing from the wounds seemed to stop, but on the following morning, July 13, the little patient was in a distressing condition. He was apathetic and semicomatose, and his respirations labored and gasping. The temperature was 102° , and the pulse, which during the night had reached 180, had now become imperceptible. The tongue protruded, and the

patient was so weak and exhausted that he could not swallow any nourishment. The skin was decidedly waxy in appearance, the mucous membranes were slightly cyanotic.

The blood at this time, showed hæmoglobin 12 per cent., and less than 1,000,000 erythrocytes. The donor was quickly summoned and brought to the operating room with the child, and each was placed on the operating table ready for transfusion. The child was given one-eighth grain and the donor one-quarter grain of morphine hypodermically. For the exposure and dissection of the left radial artery of the donor I used a solution of $\frac{1}{4}$ per cent. cocaine; to an ounce of this solution ten minims of adrenalin 1:1000 had been added. After having dissected what I thought was the radial artery, I was perplexed on account of its small size and entire absence of pulsation in this vessel, and for a time I thought that I had to deal with an anomalous condition of the blood-vessels. The radial vein seemed a mere thread in size. I severed the artery and applied hot saline pads. At first three or four drops of blood appeared, and then there followed a good spurt of bright red blood. The Elsberg cannula was then applied. The distal end of the artery was cuffed over the cannula with the aid of the little tenacula designed for that purpose, and covered with saline pads. The femoral vein of the child was now rapidly exposed and lifted by two ligatures, the distal one being tied. This dissection was carried out without any anæsthesia, and there was no apparent objection on the part of the child, which lay almost lifeless on the table. I succeeded in introducing the cannula into a lateral opening of the femoral vein and opened the cannula.

After ten minutes there was a very slight change in the color of the lips, but there was only an occasional flutter of the child's pulse. The operating tables were of unequal height and could not be properly adjusted to favor an uninterrupted anastomosis, so I abandoned the femoral vein, and decided to try the upper extremity of the child. The basilic vein of the right arm was rapidly exposed, and although the vessel was of small calibre I succeeded with the aid of the little tenacula in introducing the cannula, holding the cuffed artery into this lumen. In the course of ten minutes the child showed the effects of the transfused blood by a gradual return of pulse and color. The transfusion was continued for twenty-eight minutes. At the end of that time, the

pulse was regular, of good quality, and 140 in frequency. The ears, cheeks, and lips, previously waxy, had now become pink. The hæmoglobin taken and measured with the Talquist scale recorded 70 per cent. and the child, previously having the appearance of a limp, lifeless body, was now transformed into a healthy living being. He became restless, and begged for nourishment.

It was indeed a dramatic moment as we watched the new blood gradually and surely enter the vessels of the subject, and give it a new lease of life. The donor was not greatly inconvenienced by the ordeal, and although obliged to remain in an absolutely quiet position for a prolonged time in the operating room, behaved like a stoic and stood the ordeal unflinchingly.

About an hour and a half after transfusion there was a sudden rise in the temperature to 106.4° , and a pulse of 190. This gradually subsided without treatment, and 12 hours later was 99, and the pulse 140. The child partook of nourishment, and with the exception of a slight temperature, due to some infection of the wound in the thigh due to derangement of the dressing, made an uninterrupted recovery.

The principal points of interest noted were that the oozing from the wounds was not only interrupted by the transfusion but absolutely checked by it. The ecchymotic spots which had covered almost the entire body of the child gradually faded away. With the exception of one spot on the forehead which appeared as a result of a fall, no new ecchymotic spots were observed. The spot disappeared in the course of a few days instead of remaining visible for weeks as formerly. He has not vomited nor passed any blood since the transfusion.

The patient when discharged from the hospital on the twenty-eighth day of July showed a red blood count of 3,400,000, and a hæmoglobin of 60 per cent. After spending three weeks at the sea-shore, the child was brought back to the city, and an examination of his blood showed 5,000,000 erythrocytes, and 80 per cent. hæmoglobin. He has since then passed through a normal course of measles without complications. More recently, following an infected scalp wound, cellulitis developed, which required extensive incisions for

proper drainage. The wounds healed gradually without showing any tendency to hemorrhage.

In conclusion the following point of interest should be mentioned: The mother gave birth to her fourth child in August, 1909. Notwithstanding the trying experience with the first male offspring, the parents had the infant circumcised on the eighth day. The infant was brought to the hospital ten days later to be treated for continuous bleeding from the wound. The two female children of this family show no tendency to bleed.

GRAFT OF THE VENA CAVA ON THE ABDOMINAL AORTA.

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I. INTRODUCTION.—The operation consisted of transplanting between the cut ends of the abdominal aorta a segment of vena cava. Its purpose was to study the details of the technic of the graft of a large vein on the aortic trunk and its remote results. It is important to know whether venous segments can replace parts of the aorta as successfully as parts of smaller arteries, the carotid for instance. Five years ago, I advocated the use of venous grafting in the treatment of aneurisms and of certain traumatic lesions of arteries.¹ It was warranted by the results of experiments that I had performed in 1902 in Lyons with Morel² and in 1905 in Chicago with Guthrie.³ These experiments had shown that arteriovenous anastomoses made with a proper technic remain normal, and that a vein, transplanted on an artery, reacts against the increase of blood-pressure by thickening its wall. They demonstrated that veins can be safely grafted on arteries. At this time, it was believed that the successful arterial transplantation of a vein was not possible. Exner⁴ had attempted several times to graft a segment of jugular vein on the carotid artery. The vein always became occluded. The results of Hoepfner⁵ and of Goyanes⁶ had also been negative. Payr⁷ concluded that thrombosis was due to the action of the arterial blood-pressure on the thin venous wall, and that this biological factor rendered impossible the success of a venous transplantation. A short time afterwards, I was able to repeat these experiments at the University of Chicago. I found immediately that the thrombosis observed by previous experimenters was not due to a

biological but merely to a surgical cause, and that, with a proper technic, positive results could easily be obtained. Our experiments of 1905 and 1906 showed that arteriovenous anastomosis remained normal after twenty months. They also permitted the study of anatomical modifications of the venous wall under the influence of the increased blood-pressure. Eight months after the graft of a segment of jugular on the carotid, the circulation was found to be normal through the vein, the wall of which had become as resistant as an arterial wall.⁸ It was, therefore, certain that veins followed the law of adaptation of organ to function, and that they could, when they were compelled to do so, play the rôle of arteries. In other experiments, made in 1907 and 1908 at the Rockefeller Institute, I was able to follow more closely the histological evolution of segments of jugular vein transplanted on the carotid, and observe that twenty months after the operation the venous segment was still in excellent condition.

These results have been confirmed by other experimenters in America and Europe. In 1907, in the laboratory of Harvey Cushing at Johns Hopkins University, Watts⁹ performed several times the graft of a segment of jugular vein on the carotid artery. He found that the vein adapted itself to arterial function. Stich,¹⁰ during the experiments made in 1907 and 1908 in the Klinik of Garré, was able to follow the evolution of a venous segment grafted on a carotid artery for 409 days. Fischer and Schmieden¹¹ also obtained positive results. In 1909, at the Pasteur Institute, Frouin¹² performed some arteriovenous anastomoses which became occluded after a few months. He did not realize that the occlusion was due to his defective technic, and concluded that it was the normal evolution of the anastomoses.

The information given by these experiments has been used only twice in human surgery. Goyanes performed, in 1906, an incomplete transplantation of the popliteal vein on the popliteal artery after extirpation of an aneurism, and his patient recovered. In 1907 in a case of axillary aneurism, Lexer¹³ performed a graft of a segment of saphenous vein.

but his patient, whose general condition was very bad, died after a short time. On human beings, the technic of the arteriovenous anastomoses is easier than on dogs. They should be as successful, if they are performed with a proper technic and when the anatomical conditions of the artery allow it.

From an experimental stand-point the transplantation of venous segments can yield excellent results, even after a long time, when the operation is performed on dogs' carotid arteries. It is important to know whether these results will be different in case of larger and more friable vessels in which the blood-pressure is higher.

II. TECHNIC AND EXPERIMENTS.—The animals were etherized and their abdomens opened by a transverse semicircular laparotomy. The graft of the vena cava to the aorta was composed of four stages.

1. *Extirpation of a Segment of Vena Cava.*—At a short distance below the mouth of the renal veins, the vena cava was dissected and isolated between two ligatures. A venous segment very much longer than the arterial segment to be replaced was resected. It was then washed in Locke's solution, and deposited in a jar of vaseline.

2. *Temporary Hæmostasis, Section, and Resection of the Aorta.*—The abdominal aorta was dissected at the level of the genital arteries. The lumbar collateral branches were forcipressed or ligated. Between two Crile forceps, a long segment of aorta was isolated and a small part of it resected. As soon as the aorta was cut, the blood was washed out by an injection of Locke's solution. The vessel and the operative region were covered with vaseline, and isolated from the surrounding structures by black Japanese silk towels.

3. *Graft of the Vena Cava.*—The venous segment was removed from its jar, and interposed between the cut ends of the aorta, after the vaseline had been expressed from its lumen. The anastomoses were made by the ordinary method. Straight Kirby needles, No. 16, and fine silk threads, sterilized in vaseline, were used. The ends of the vessels were united by

three retaining stitches and a continuous through-and-through suture. As the diameter of the vena cava was larger than the diameter of the aorta, the calibre of the vena cava was progressively reduced. This could be done easily by leaving a larger distance between the stitches on the vein than on the artery. In order to secure an accurate approximation of the internal surfaces and a narrow scar, the edge of the vein was slightly eversed, the stitches were as loose as possible, and great care was taken not to include any connective tissue in the line of suture.

4. *Re-establishment of the Circulation.*—The Crile forceps placed on the lower end of the aorta was removed, and the blood entered the grafted segment. The sutures and the ligatures of the collateral branches of the vena cava were examined. The anastomoses were slightly compressed with dry gauze pads. The upper forceps were removed and the circulation re-established. After an arteriovenous anastomosis, the lines of sutures leak more or less for a few minutes, after which the hemorrhage stops spontaneously. If after two or three minutes there is still some hemorrhage, one or two stitches are added. The operation must not be ended before it is certain that not a drop of blood is oozing from the lines of suture. When the condition of the circulation was normal, the operation was completed by suture of the lumbar peritoneum and the closing of the abdominal section by four or five planes of suture. The animals were dressed and after a few hours allowed to walk and eat as usual.

Three experiments were performed on two cats and one dog.

Experiment 1: Transplantation of a segment of vena cava between the cut ends of the abdominal aorta.

Large yellow male cat. July 10, 1907. Dissection of the vena cava below the renal arteries. A segment three centimetres long is extirpated. Resection of the right kidney. Dissection and section of the aorta a few centimetres below the renal arteries. Graft between the ends of the segment of vena cava. July 15: Cat in normal condition. Normal pulsations of the femoral arteries. October 1: Cat in excellent health. No change in the femoral pulse. April 15, 1908: Femoral pulse normal. Cat slightly ill. April 25: Cat is sick. Femoral pulse normal. May 1.

1908: Pulse has disappeared. Animal walks normally. May 8: The animal is very sick. No femoral pulse. Killed by chloroform.

Autopsy.—Pyelonephritis, with perinephritic abscess. Obliteration of the transplanted segment by a clot of recent formation which is adherent to the wall. The aorta above and below the transplanted segment is normal. The calibre of the segment is almost the same as it was at the time of the operation. There is no sclerosis of the surrounding connective tissue. The venous wall is about the same thickness as the aortic wall. The internal surface of the lower part of the transplanted segment is smooth and glistening. On the upper part it is covered by a red clot, which is adherent to the wall at about one centimetre below the upper anastomosis. Both anastomoses are in perfect condition, smooth and glistening, and almost invisible. *Histological Examination.*—A small piece of the wall is cut at the level of the lower anastomosis. Section 97. Hæmatoxylin eosin and Weigert's elastic tissue stain. Longitudinal section of the vessel, showing the lower anastomosis and the adjoining parts of the aorta and vena cava. The wall of the vena cava is a little thicker than the wall of the aorta. The aortic wall is normal. Venous wall is composed of connective tissue with a few elongated cells. There are apparently no muscular cells. The union of the vena cava and of the aorta is very smooth. The aortic wall is slightly everted outward at the point of union. Very few elastic fibres in the venous wall, which is almost entirely composed of connective tissue.

Experiment 2: Resection of a small segment of the aorta of a cat. Graft of a segment of vena cava.

Large white male cat, very old. March 24, 1909, 10 A.M. Extirpation of a segment of vena cava of about 35 millimetres, just below the renal vein. Resection of a short segment of aorta at the level of the spermatic arteries. Graft of the vena cava between the cut ends. 3 P.M.: Animal walks about its cage. April 20: Femoral pulse normal. Animal is very fat and in good health. May 20: Animal is sick. Femoral pulse normal. May 25: Animal died.

Autopsy.—Sclerosis of the kidneys. Fatty degeneration of the liver. *Macroscopical Examination.*—The transplanted segment is 34 millimetres long. Its calibre is larger than the calibre of the aorta. It does not seem more dilated than at the time of the operation. The walls of the aorta and vena cava are about of the same thickness. The internal surface is glistening, and slightly irregular. The anastomoses are excellent, without dilatation or stenosis. *Microscopical Examination.*—Hæmatoxylin eosin and Weigert elastic tissue stain. On a cross section of the transplanted segment, at about its middle part, the wall is composed of two parts—external and internal. The external coat is a very thick and well-vascularized adventitia; the internal part is composed of the media and of the intima. The media consists chiefly of very dense connective tissue and of elongated cell nuclei. Longitudinal section of the upper anastomosis shows the media of the aorta slightly bent outward and in perfect union with the vein (Fig. 1). There are no elastic fibres in the venous wall (Fig. 2).



Longitudinal section of the upper interocular region. (Hematoxylin-Eosin stain.)

FIG. 2

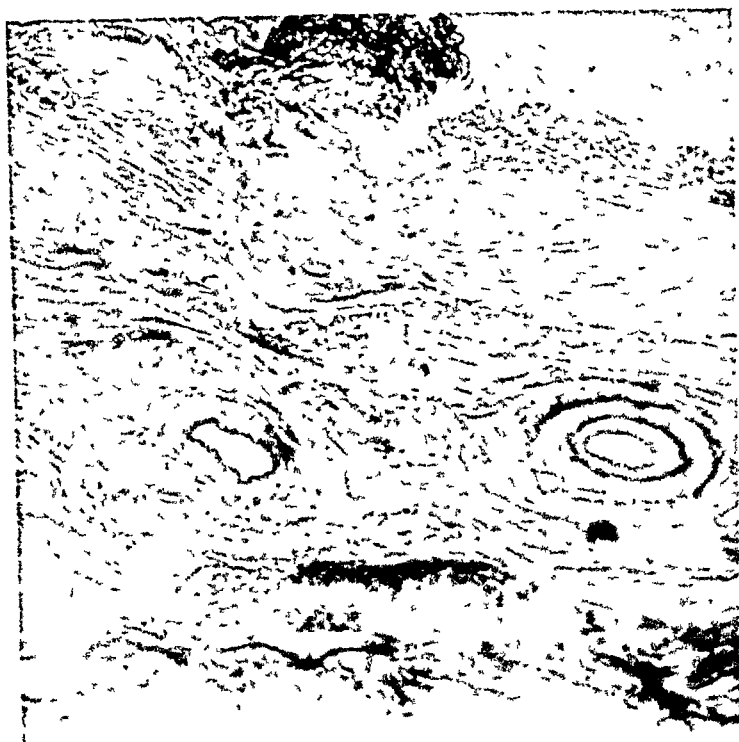


FIG. 3.



Segment of vena cava transplanted on the abdominal aorta. Experiment 3. Fourteen months after the operation.

FIG. 4.



Venous wall, fourteen months after the transplantation. Experiment 3.

Experiment 3: Resection of a segment of the abdominal aorta patched with peritoneum. Graft of a segment of vena cava.

Middle-sized white bitch. November 24, 1908. Dissection of the abdominal aorta, a piece of which had been resected twenty-two months ago and replaced by a patch of peritoneum. Section of a segment of vena cava below the renal arteries. Resection of the patched segment of the aorta. Graft of the vein between the cut ends of the aorta.

November 25, 1908: Animal in good condition. Her hind legs are swollen. December 5, 1908: Œdema has disappeared almost completely. Animal in excellent condition. July, 1909: Animal normal. Normal femoral pulse. January 13, 1910: Animal died at the farm after an illness of a few days.

Autopsy.—Double pneumonia. Dissection of the aorta and of the venous segment which is 36 millimetres long. Its calibre has not markedly increased. The wall is very much thicker and a little transparent. The internal surface of both vessels is perfectly smooth and glistening, and anastomoses are excellent (Fig. 3). *Microscopical Examination.*—Intima a little thickened. The interstitial connective tissue has very much increased. The muscle-fibres are normal and seem to be increased in number. Very marked thickening of the adventitia (Fig. 4).

III. RESULTS.—The three animals which underwent the transplantation of the vena cava on the abdominal aorta were in normal condition a few hours after the operation and recovered without any complication. In Experiment 3, the posterior limbs of the dog became swollen on account of the ligature of the vena cava but, after a short time, the œdema disappeared completely. No modification of the femoral pulse was observed. The causes, which after several months brought about, directly or indirectly, the death of the animals are completely independent of the operations. In Experiment 1, the cat was chloroformed ten months after the operation because he had developed pyelonephritis. The cat of Experiment 2 was very old. Three months after the operation, he became sick and died. The autopsy showed fatty degeneration of the liver and sclerosis of both kidneys. The dog of Experiment 3 lived in perfect health for fourteen months and then died of pneumonia in a few days.

Therefore, three months, ten months, and fourteen months after the operation the abdominal aorta of the animals and its venous segment were extirpated for the study of the anastomosis and of the venous wall.

Before longitudinal opening of the vessel the anastomoses

could not be precisely located. There was no hardening of the wall at their level. The surrounding connective tissue was not sclerosed. In Experiment 1, the segment was occluded by a clot of recent formation. But, both anastomoses were normal. Their lumen was free. The scar was indistinct. The exact location of the anastomosis was determined by the difference in color between the venous and the aortic walls. In Experiment 2, there was a linear scar. In Experiment 3, the scar was also very narrow and almost invisible (Fig. 3). But the location of the anastomoses was easily detected because the aortic wall assumed a white color while the venous wall was slightly bluish. The union between the ends of the aorta and the segment of vena cava was very intimate. The media of the aorta bent slightly outward and ended abruptly. On its internal surface, the intima increased progressively in thickness, the artery united itself to the vein without interposition of scar tissue. The histological appearance of the anastomoses after the operation shows that the results are definitive (Figs. 1 and 2). The secondary occlusions observed by Frouin are certainly the result of a fault of technic. When an arterio-venous anastomosis is made by a proper method, no modification of its lumen can occur even after a long time.

The venous segment underwent a slight increase of its calibre and a very marked thickening of its wall (Fig. 3). In every experiment its diameter appeared to be slightly enlarged. The changes of the wall were very marked. In Experiment 1, the venous segment was occluded by a clot of recent formation, which developed after the occurrence of pyelonephritis. Above and below the thrombus, the venous wall was smooth and glistening. In Experiments 2 and 3, the internal surface of the wall was perfectly smooth. There was a slight difference in color between the aortic and venous walls. The wall of the vena cava was a little thicker than the arterial wall. It had lost all elasticity, and did not contract when the circulation was stopped. It was composed in Experiments 1 and 2 of dense connective tissue, the adventitia and the media being very much increased. Development of new elastic fibres was not observed (Fig. 2). In Experiment 1, the muscle-

fibre nuclei disappeared. In Experiment 3, the muscle-fibres were found normal (Fig. 4). The thickening of the wall was due chiefly to a very marked sclerosis of the adventitia and of the media. It seemed that the number of the muscle-fibres had increased.

The adaptive changes of the vein begin immediately after its grafting on the artery. The wall thickens. There is, at first, an increase in the connective tissue, and probably also an increase in the number of the muscular fibres. Stich has observed the development of new elastic fibres. I observed it also in a few cases. But often, as it is shown in Experiments 1 and 2, there is no production of new elastic fibres. The elastic framework of the aorta stops abruptly at the point of anastomosis, and the venous wall is seen completely lacking in elastic tissue (Fig. 2). It seems that the first changes undergone by the vein can be compared to hypermyotrophy observed by Russell¹⁴ in the first stage of certain forms of arteriosclerosis. It is a functional hypertrophy due to the increase of blood-pressure. It is not due to a change of nutrition produced by the arterial blood, because I found changes of the same nature in arteries in which the pressure was slightly raised, without any modification of the blood.

It is then certain that the first result of the increase of blood-pressure is an hypertrophy of the wall as it was shown long ago by Adami.¹⁵ The vein has a tendency to become an artery. My experiments demonstrate that it can play perfectly its rôle. But it is possible that in some cases the wall undergoes a progressive sclerosis and that the muscle-fibres disappear completely after a few months. Four months after the transplantation of a segment of jugular on the carotid artery, I extirpated a small part of the wall and sutured the opening. The wall was very thick and composed of a sclerosed media containing normal muscle-fibres and of a greatly hypertrophied adventitia. Twenty months after the operation, the wall was examined again and modified. Sclerosis had increased and all the muscle had disappeared. This change did not interfere at all with the functions of the vena segment. Many experiments have shown that the presence of muscular

or elastic fibres is not necessary to the normal function of an artery. However, sclerosis of the wall may lead to atheromatous changes, although it has not yet been observed. But it will be necessary to keep under observation animals with veins transplanted on arteries for eight or ten years in order to be sure that these degenerative changes do not occur. The knowledge of the remote results of these operations will decide whether fresh veins or arteries, fresh or preserved in cold storage, must be selected as grafts.

IV. CONCLUSIONS.—The transplantation of the vena cava on the aorta is not a dangerous operation. The three animals operated on recovered without incident.

The venous wall reacts against the arterial blood-pressure by thickening its wall.

The condition of the venous wall and of the anastomoses examined fourteen months after the operation shows that, for a long time, a segment of vena cava can functionate as a part of the abdominal aorta.

It is probable that in the treatment of aneurism, rupture of large arteries, embolus, and localized arteritis, the transplantation of venous segments can be used safely, but it must be emphasized that without a proper technic, the results of the operation will be disastrous.

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A SUGGESTION FOR THE TREATMENT OF AIR EMBOLISM.

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THE object of this paper is to present the results of a study of air embolism with especial reference to its treatment. In this study other observations were of necessity made, but as these are mainly corroborative of work that has already been published—especially the work of Senn and Hare—a very brief account of it will be given.

Senn, in 1885,¹ reported an extensive experimental and clinical study of air embolism. Wherever our work has been in common with his, we are entirely in agreement. Our motive in attacking the problem was different from his and our methods are different. Hare² reported an extensive research done on dogs, which is entirely in agreement with the results of Senn and was done without any knowledge of Senn's work. Goodridge³ criticizes previous work but adds nothing new. Ezra Read Larned⁴ gives results corresponding to those of Senn and Hare. In these four papers, especially those by Senn and Hare, a complete literature of air embolism is given.

When air in quantity suddenly enters the veins, it may be rapidly fatal (see Experiments 5 and 7, Figs. 2 and 3). The fatal dose varies enormously with the same and different species. (Compare Experiment 14, Drum 2, Fig. 6, points 2, 3 and 4 in which the dog received 90 c.c. of air in the jugular under pressure in four minutes, from which he recovered with-

out treatment, also Experiment 21, Fig. 11, in which a dog aspirated about 175 c.c. air into the jugular in twenty-eight minutes with practically no serious effect, with Experiment 20, Fig. 10, in which a dog aspirated less than 15 c.c. of air in eleven minutes, which was almost immediately fatal.) As pointed out by Senn, Hare, Larned and others, in almost all animals the fatal dose is very much larger than is generally believed. The causes of death we have found are: (1) cardiac insufficiency due to a mechanical and to a vital cause; (2) respiratory failure.

When the air enters the right ventricle the auriculoventricular valve of that side does not close, and the light elastic air in the venæ cavæ allows regurgitation from the auricle. In the form of a coarse froth the air is churned backwards and forwards in the venæ cavæ with each contraction. This backward and forward motion of the air in large bubbles could be seen in the glass cannula in the jugular vein (see under method). The heart's effort is also apparently lessened. (See Experiment 11, B, Fig. 5, which shows a tracing of the excursion of the ventricular wall.) It will be seen that after each injection of 4 c.c. of air the contraction of the heart is considerably disturbed and is for a time less efficient. This may be due to lack of the stimulus of blood in the cavities. As a result of these two factors combined, little or no blood reaches the left ventricle, and the whole circulation including the coronary is stagnated, with consequent bulbar anæmia, causing respiratory failure, and cardiac anæmia, causing a real weakness and deterioration of the heart muscle. The possible influence of inhibitory impulses reaching the heart through the vagus is a subject that is reserved for further investigation.

It has been disputed whether cardiac or respiratory failure is the primary cause. In every case we found that the respiration stopped first, and if artificial respiration was carried out effectively, the heart in some cases would again resume normal function. While the respiration first fails and the heart continues to beat, yet the respiratory failure is dependent on the heart. Though the heart continues to beat, it throws out very

FIG. 1



Experiment 1. Dog revived of itself. Experiment 11. Cat revived with 0.5 saline.
Experiment 12. Cat which failed to revive with 0.5 saline was revived with 0.5 saline and
adrenalin. Experiment 14. Dog 31. Dog revived with adrenalin in a concentrated
solution

FIG. 2



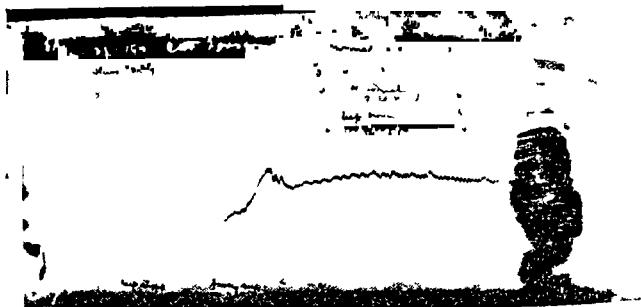
Experiment 14

FIG 3.



Experiment 7

FIG 4



Experiment 8

FIG 5



Experiment 11B

FIG 6



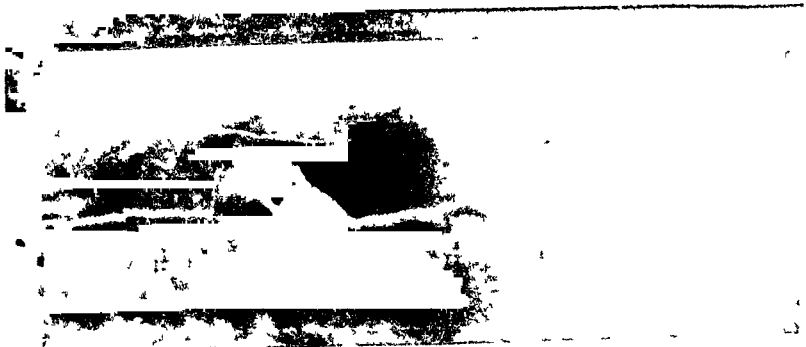
Experiment 14, Drum 2

FIG 7



Experiment 15

FIG 8



Experiment 17

FIG. 9.



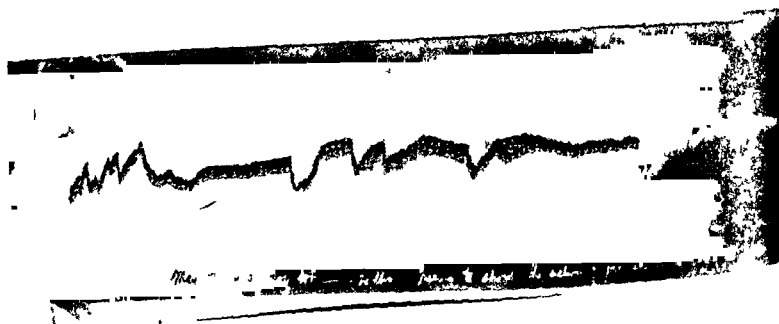
Experiment 18

FIG. 10.



Experiment 20

FIG. 11.



Experiment 21.

little blood, and because of this respiration stops from lack of nutrition of the respiratory centre.

The treatment that has so far been proposed has been both direct and indirect. It may be stated under the following headings: (1) the prevention of the admission of air by compression or ligation or both; (2) venesection; (3) cardiac stimulants; (4) direct aspiration of the heart and infusion of saline solution; (5) catheterization and aspiration of the right auricle to remove air and spumous blood and to relieve overdistention.

No doubt the proper use of any of these methods is of value. Some, however, are extremely heroic and others, apparently without danger, we have found to be decidedly detrimental. Many cases of air embolism, if left alone and untreated, will recover (see Experiment 4, Fig. 1). It must be an accident of very rare clinical occurrence but if it does occur, treatment to be effective must, in most cases, be quickly applied. The call for a comparatively conservative method, one that will be beneficial in all cases and detrimental in none, is quite obvious. It was the desire for such a method that prompted the present research.

Our first experiment in the line of treatment was to open the chest wall and attempt to re-establish the circulation by cardiac massage. This was proved futile both by the death of the animal and the failure to remove the air from the heart.

The next therapeutic attempt more nearly approached a clinical possibility, and was based on the theory that if the right heart could be but partially filled with fluid under pressure it would help to sweep the air into the pulmonary circulation, and the impact of the fluid against the valve cusps would cause them to close in the normal manner. We had observed that once the circulation was re-established, the vicious circle was broken, and that large quantities of air would be disposed of without causing serious embarrassment.

As an adjunct to flushing the right heart, it seemed to us that if an artery on the systemic circulation were opened, it would have the double effect of lessening the starting load and

of partially compensating for the quantity of salt solution that we proposed to throw into the right heart. Though we did succeed in at least hastening the recovery of one animal (Experiment 1, Fig. 1) by this method, it did not work out as we had hoped. In most cases it failed and it proved more apt to cause paralysis of the heart than restoration of function. While we were carrying on this work, L. von Lesser⁵ reported the simple infusion of saline as valuable; Von Lesser used 0.5 per cent. NaCl solution. We found no sufficient merit in the method. Not only does the method of simple saline infusion seem to have little to recommend it in any case, but it is decidedly dangerous. The heart is already weak and tends to dilate. When salt solution is injected quickly and in volumes sufficient to help sweep the air out of the heart, it almost invariably causes a dilatation that is harmful, often fatal. In several experiments, in running the saline into the vein at 90 cm. of water pressure, the heart suddenly ceased beating and on opening the chest no beat could be observed, but on simply opening the pericardium an ineffective beat was resumed. If the saline solution be injected slowly, it is of no value, although Goodridge advises injection into the median basilic vein in conjunction with direct aspiration of the heart with a fine trocar.

From what we observed while working on this method, it seemed that the fault lay in the fact that the heart would not respond to the extra load, and that if some powerful instantaneous cardiac stimulant could be brought to bear this fault might be overcome. The addition of adrenalin chloride to the salt solution proved decidedly advantageous, greatly increasing the percentage of recoveries. This is demonstrated by Experiment 3, Fig. 1, where salt solution and artificial respiration failed, but prompt recovery occurred on flushing with 50 c.c. of 0.9 saline containing 1 c.c. of a 1:1000 adrenalin chloride solution, and Experiment 8, Fig. 4, where recovery followed the use of 1 c.c. adrenalin chloride solution in 90 c.c. of 0.9 saline solution. Adrenalin in this dilution did not, however, entirely eliminate the danger of cardiac paralysis where large

quantities of fluid were rushed to the heart (see Experiment 7, Figs. 3, 9 and 13).

EXPERIMENT 1, MARCH 10, 1910.

Cat, Weight 3000 Grammes.

Time	Blood-pressure Hg.
12.15: Normal blood-pressure	92 mm.
12.15: 1 c.c. air, blood-pressure immediately	74 mm.
12.18: Blood-pressure	84 mm.
12.20: 3 c.c. air in jugular	52 mm.
12.22:	28 mm.
12.22: 100 c.c. normal salt sol. in jugular	
12.27: Blood-pressure	60 mm.
12.38: Blood-pressure	88 mm.
1.00: Cat, normal, killed.	

Autopsy: no air could be found in any of the organs.

EXPERIMENT 2, MARCH, 1910.

A number of experiments were made that are not recorded here. In most instances the injection of air, saline, or adrenalin, and the resulting blood-pressure are recorded as being synchronous, but in reality the blood-pressure reading was made a fraction of a minute later than the injection.

Cat, Weight 4100 Grammes.

Time	Blood-pressure Hg.
11.45: Normal blood-pressure	180 mm.
11.46: 3 c.c. air in jugular	140 mm.
11.46½:	184 mm.
11.47: 4 c.c. air	108 mm.
11.49:	170 mm.
11.50: 4 c.c. air	98 mm.
11.51: 4 c.c. air	70 mm.
11.52:	110 mm.
11.52½: 4 c.c. air	50 mm.
11.54:	28 mm.

Commenced to run in salt solution at a pressure of 90 cm.
water—no recovery.

EXPERIMENT 3, MARCH 9, 1910.

Cat, Weight 2500 Grammes.

Time	Blood-pressure Hg.
12.07: Blood-pressure	120 mm.
12.08.5: 4 c.c. air in jugular	42 mm.
12.09.5: Commenced to run in salt solution in jugular—100 c.c. run in.	
12.11: Artificial respiration.	

Time	Blood-pressure Hg.
11.49:	170 mm.
12.12: No heart-beat felt—respiration very slow, blood-pressure.	30 mm.
12.12: Adrenalin 1 c.c. in 100 c.c. saline ran into jugular.	
12.14: Blood-pressure	130 mm.
12.15: 47 c.c. blood drawn from femoral.	
12.17: Respiration jerky but becoming normal.	
12.43: Animal in good condition, blood-pressure.....	120 mm.

In this case after salt solution had failed, the animal was in very poor condition; adrenalin caused a complete recovery.

Postmortem.—The heart was normal, no air could be found in any of the organs.

EXPERIMENT 4, MARCH 12, 1910.

Cat, Weight 1500 Grammes.

Time	Blood-pressure Hg.
10.00: Normal blood-pressure	108 mm.
10.03: 3 c.c. air in jugular, pressure falls to.....	68 mm.
10.07: Blood-clots in cannula	92 mm.
10.08: 4.5 c.c. air in jugular	20 mm.
10.09: Respiration very slow and deep and at,	
10.09.5: Respiration practically ceased, heart impulse can still be seen, blood-pressure	22 mm.
10.10.5: Great dyspnœa, blood dark and clots readily, blood- pressure	28 mm.
10.12: Respiration and heart improved	32 mm.
10.18: Respirations 3 per minute	42 mm.
10.30: Respiration regular, 14 per minute	84 mm.
The animal here normal so far as can be judged.	
10.31: 4.5 c.c. more air in jugular and pressure falls quickly to 22 mm.	
10.40: No respirations in 2 minutes and heart-beat scarcely perceptible.	
10.41: Artificial respirations commenced and 0.5 c.c. adrenalin in 60 c.c. salt solution injected into jugular. But treat- ment apparently without result. Heart-beat revived but continuous cardiac massage necessary, and heart stops on withdrawing the treatment.	

Postmortem.—11.00: Air was found in both sides of the heart and in the coronary veins. When the heart was removed from the body it still beat but not effectively. More prolonged treatment might have been effective.

Results.—This small animal recovered completely from a large volume of air without treatment. As a smaller volume has killed a larger animal, this fact makes it difficult to place a true estimate on treatment, as the animal, if left alone, recovers in many cases.

EXPERIMENT 5, MARCH 16, 1910.

Cat, Weight 3500 Grammes (Male).

Time	Blood-pressure Hg.
10.03: Normal pressure	164 mm.
10.05: 4.5 c.c. air in jugular	80 mm.
10.07:	150 mm.
10.09: 4.5 c.c. air in jugular	30 mm.
11.12: 40 c.c. salt solution	20 mm.
Containing 1 c.c. adrenalin, this was repeated in 1 minute —no sign of recovery.	
11.20: Animal dead.	

Postmortem.—Clot in right heart. Air in right heart, lungs, and inferior vena cava back to liver, no air in left heart.

EXPERIMENT 6, MARCH 19, 1910.

Cat, Weight 1600 Grammes.

Time	Blood-pressure Hg.
10.40: Normal pressure	128 mm.
10.41: 4.5 c.c. air in jugular	4 mm.
Animal died immediately, adrenalin in salt solution; bleeding gave no signs of recovery.	

EXPERIMENT 7, MARCH 16, 1910.

Cat, Weight 2500 Grammes.

Blood-pressure 134 mm. Was injected with 9 c.c. air—pressure fell at once to zero and treatment with adrenalin and salt was ineffective.

Autopsy.—Showed air in all abdominal veins, air in right heart, no air in left heart, not dilated.

EXPERIMENT 8, MARCH 23, 1910.

Cat, Weight 2000 Grammes.

Time	Blood-pressure Hg.
10.20-23: Normal blood-pressure	118 mm.
10.23: 6.5 c.c. air in jugular	10 mm.
10.25: Respiration stopped, no heart-beat perceptible; 1 c.c. adrenalin in 90 c.c. salt solution and pressure immediately rises.	
10.26: Respiration jerky and becoming more frequent.	
10.28: Respiration labored but becoming more regular.....	120 mm.
10.30: Animal normal in respiration and pressure.....	120 mm.
10.37: Animal killed.	

Postmortem.—No air found in any organs, all normal. In this case the adrenalin may have been the direct cause of recovery.

EXPERIMENT 9, MARCH 25, 1910.

Cat, Weight 2350 Grammes.

Time	Blood-pressure Hg.
11.15 : Normal pressure	140 mm.
11.16 : 9 c.c. air in jugular.	
11.16.5: Respiration stopped, heart still beating.....	10 mm.
11.17.5: Respiration 1 per minute.	
11.18.5: Heart 180 per minute.....	8 mm.
Adrenalin salt solution and artificial respiration gave no sign of being beneficial.	
11.30 : <i>Autopsy</i> —air in right and left heart and vena cava. After the removal of the air the heart commenced to beat. In this case after the adrenalin had been used without effect, aspiration might have been beneficial.	

EXPERIMENT 10, MARCH 26, 1910.

Dog, Weight 6350 Grammes.

Time	Blood-pressure Hg.
11.14: Normal pressure	160 mm.
11.15: 9 c.c. air in jugular	140 mm.
11.15¾: Respiration labored, pressure	160 mm.
11.18.5-11.19.5: 35 c.c. air injected	68 mm.
11.20:	164 mm.
11.35: Animal normal, pressure	160 mm.
11.38.5: 50 c.c. air injected	50 mm.
11.40:	160 mm.
11.45: 170 c.c. air injected	20 mm.
11.46: Respiration stopped, heart weak, injection of salt solution 100 c.c. 0.9 and adrenalin in 1 c.c. caused a slight improvement.	
11.48: Dog gasping	40 mm.
100 c.c. more salt solution containing 1 c.c. adrenalin and artificial respiration gave no further improvement.	
11.50: Animal dead.	

Autopsy.—Air in all chambers of heart and abdominal vessels.

EXPERIMENT 11, APRIL 12, 1910.

100 c.c. air killed a 20 lb. dog and all treatment was useless. Death immediately, heart dilated and air in both sides.

11A. 50 c.c. killed a 17 lb. dog immediately; by the injection of 300 c.c. salt solution in jugular, bleeding from the carotid, we were able to wash some of the air out of the heart, but this treatment was ineffective. The heart continued to beat weakly after respiration ceased.

11B. Shows a myocardiogram of cat during repeated injections of 4 c.c. air.

Experiment 12 similar to 11.

EXPERIMENT 13, APRIL 20, 1910.

Dog, Weight 24 Pounds.

Time	Blood-pressure Hg.
11.35 : Normal blood-pressure	124 mm.
11.40 : 40 c.c. air in jugular	78 mm.
11.41 :	140 mm.
11.46 : 50 c.c. air	28 mm.
11.46.5 :	28 mm.
11.48 : Respiration stopped; 1 c.c. adrenalin in 100 c.c. salt solution ran in at 50 cm. water pressure gives no improvement.	
11.49.5: Heart flickering, artificial respiration does no good.	

Autopsy.—A little air in abdominal veins. None in the small veins. Air in right ventricle and pulmonary arteries but none in left ventricle.

EXPERIMENT 14, APRIL 20, 1910.

Dog.

Time	Blood-pressure Hg.
12.36: Normal pressure	140 mm.
12.39: 35 c.c. air in jugular, respiration becomes very rapid and pressure falls to	62 mm.
12.40.5: Pressure	144 mm.
12.41: 25 c.c. air injected, hyperpnœa and pressure falls to.....	80 mm.
12.43: Pressure	140 mm.
30 c.c. air injected, respiration resembles vomiting movements and pressure falls to	54 mm.
12.46: Pressure	150 mm.
12.48: 1 c.c. adrenalin in 4 c.c. saline injected—typical adrenalin action.	
12.52: Pressure	100 mm.
12.53: Stopped to clean out clot.	
1.01.5: Normal pressure	130 mm.
1.02: 40 c.c. air in jugular, pressure falls to	75 mm.
1.03.5: Respiration stopped, pressure	75 mm.
1 c.c. adrenalin solution injected gives typical adrenalin rise.	
1.04: 75 c.c. blood taken from femoral.	
1.07:	58 mm.
1.08: 230 c.c. salt solution injected at a pressure of 30 cm. water.	
1.15: Steady for 5 minutes at	80 mm.
Experiment stopped and animal killed.	

Autopsy.—No air found in heart, lungs, or large veins, or coronary arteries. Organs apparently normal.

Results.—Adrenalin quickly restored animal after respiration had ceased, but while pressure was still high. Unquestionably the animal

would have recovered without treatment, but recovery was much quicker with it. Bleeding relieves the pressure and allows the adrenalin to act on the heart without the probability of danger from high blood-pressure. A remarkable feature was the complete absorption of 130 c.c. of air in 40 minutes or less.

EXPERIMENT 15, APRIL 27, 1910.

Dog, Weight 28 Pounds.

Time	Blood-pressure Hg.
11.05: Blood-pressure	124 mm.
11.05.5: 50 c.c. air in jugular.	
11.06: Pressure	70 mm.
11.07: Pressure	140 mm.
50 c.c. air injected.	
11.08: Respiration stopped, heart very weak, pressure.....	28 mm.
1 c.c. adrenalin in 80 c.c. salt solution at 45 cm. water pressure. Immediate good effect.	
11.09: Pressure rising rapidly and respiration improving.	
11.10: Blood-pressure	140 mm.
11.15: Blood clotting	110 mm.
11.25: Respiration normal, blood-pressure	138 mm.
The treatment here is unquestionably effective.	
11.30: Blood-pressure	120 mm.
11.30.5: 90 c.c. air injected.	
11.31: Respiration stopped, heart very weak, blood-pressure....	16 mm.
Adrenalin, artificial respiration, vagi cut and salt solution—could not restore animal.	
11.50: Chest opened and direct massage of the heart restored beat.	
11.52: Heart revived and in good condition.	
11.58: Experiment stopped.	

Postmortem.—Air in the vena cava and right heart, none in left heart.

Results.—Adrenalin was decidedly beneficial in this case. This is especially the case when the heart is almost able to overcome the obstruction without help. When the blood-pressure falls to almost zero and quickly it is of less value. When a very large volume of air is injected adrenalin fails.

EXPERIMENT 16, APRIL 28, 1910.

Dog, Weight 25 Pounds.

Time	Blood-pressure Hg.
11.17: Normal blood-pressure	164 mm.
11.18: 100 c.c. air in jugular, pressure immediately falls, and at	
11.20:	18 mm.

Adrenalin and salt solution was ineffective. The animal died without the faintest appearance of recovery. This amount of air forced into the heart makes it impossible to force in salt solution and adrenalin. In

fact, if the cannula is open, much of the air would pass out through the same veins that it entered. Such an amount of air could but slowly enter the heart at normal pressure.

EXPERIMENT 17.

Dog, Weight 16 Pounds.

This experiment was made to demonstrate the antagonistic effects of air and adrenalin on the heart.

Time	Blood-pressure Hg.
11.38: Normal blood-pressure	130 mm.
11.43: Normal blood-pressure	130 mm.
11.43: 50 c.c. air used to force in adrenalin. There was no fall in this case. A small adrenalin rise which soon reached normal again.	
11.46: Blood-pressure	132 mm.
The above injection was repeated with like results.	
11.48: Blood-pressure	130 mm.

The air in this case, 100 c.c. in a small dog, caused no fall of pressure.

Postmortem.—Air in the pulmonary artery. Fine bubbles of air in right heart but none in left; heart beat strong for some time after removal from body.

EXPERIMENT 18.

Dog, Weight 10 Pounds (Good Tracing).

To show the influence of adrenalin injected immediately after air.

Time	Blood-pressure Hg.
12.30: Normal pressure	128 mm.
12.35: 40 c.c. air followed immediately by 0.4 c.c. adrenalin.	
Pressure falls to	
Immediately begins to rise.	
12.36:	70 mm.
12.39:	120 mm.
12.45:	130 mm.
12.45.5: 50 c.c. air followed immediately by 0.4 c.c. adrenalin.	
Heart is strong in pressure and slow and gradual.	
12.47:	70 mm.
12.50:	40 mm.
After this the rise was gradually higher.	
12.52:	90 mm.
1.00:	98 mm.
1.00: 85 c.c. air.	
1.01: Pressure falls to	10 mm.
And adrenalin, salt solution and artificial respiration failed to revive.	

Autopsy.—Air in right heart and coronary veins, and abdominal veins
No air in left ventricle.

EXPERIMENT 19, MAY 6, 1910.

Dog, Weight 8 Pounds.

30 c.c. air killed this animal immediately and adrenalin was without effect—administered 1 minute after the air.

EXPERIMENT 20.

A dog, weight 9 pounds, with trachea clamped during the period of the first three respiratory efforts, and cannula in jugular connected with condom containing a measured amount of air. During 29 respirations the animal drew into the vein between 10 c.c. and 15 c.c. air, which killed it.

Adrenalin was without effect. The measuring apparatus was not perfectly satisfactory and the experiment was repeated. The imperfection here was lack of exactitude in the measurement of the air. The air was aspirated from an unstretched thin rubber bag and the possible error was within the limits named.

EXPERIMENT 21.

Dog, weight 20 pounds; with a perfect apparatus the animal could not draw in enough air to kill it.

Our next method was to introduce into the heart a rather concentrated solution of adrenalin, using a relatively small quantity of normal saline solution to carry it from the jugular vein, where it was introduced. The essential difference between this and the preceding method is that reliance is placed chiefly upon a very concentrated solution of adrenalin reaching the heart chambers and causing violent contractions. The normal saline solution is used chiefly as a carrier and in quantity sufficiently small to insure its freedom from the danger of overdilatation. The exact technic was to inject the quantity desired of the 1 : 1000 adrenalin chloride solution by means of a hypodermic into the rubber tube that leads to the cannula in the vein. By this means the adrenalin was concentrated in the first part of saline that entered the vein, the remaining saline being used to insure its reaching the heart. It is because of our apparently successful results with this drug that we report the work. Artificial respiration is often of value, whatever other treatment may be instituted.

METHODS.

Cats and dogs were used. The animals were prepared for blood-pressure tracings. A cannula was inserted in the

right external jugular close to its innominate junction, for the injection of air and adrenalin and salt solution. A continuous blood-pressure tracing was taken during the experiment, and is recorded in millimetres mercury. A measured volume of air was injected in each case. When the quantity was small, injection was made with an air-tight syringe; when over 10 c.c. it was pressed in by a syphon.

To simplify description, the general results obtained will be given, twenty-two of the series having been presented in tabular form.

Injection of air into the heart, no matter how small the quantity may be, produces a disturbance of the circulation that can readily be seen in the blood-pressure record; there are a fall of pressure, dyspnoëic symptoms, and restlessness. If the volume of air injected be small, these changes are usually extremely temporary; if large, a sudden fall of pressure to almost the base line occurs, great dyspnoëic and labored breathing, and a fluttering heart. The respiration always stops before the heart, but the ineffectiveness of the heart-beat is the cause of the respiratory failure. In other words the practically valveless right heart cannot supply blood to be pumped to the respiratory centre and the centre fails while the heart continues to beat ineffectively, the blood-pressure being almost zero. While the heart is in this condition, the injection of adrenalin is very effective in restoring the normal pressure in some cases; in others it is worthless; whether or not it is of value seemed to depend largely upon the character of the heart-beat at the time the injection was made and the length of time that had elapsed since respiration ceased. Except where air or fluid is rushed into the heart under considerable pressure, the heart-beat does not cease for some time, but the beat becomes less and less strong. Where at autopsy, after rushing air and fluid into the heart, no beat was seen, the beat always recurred on opening the heart and removing the internal pressure. In all cases where at postmortem air was found in quantity in the left heart, adrenalin was ineffective. The action of adrenalin can also be most clearly seen if it is injected with the air, or closely fol-

lowing (Experiments 17, Fig. 8, and 18, Fig. 9). In Experiment 17 the air was injected at low pressure and the adrenalin effect predominated. In 18 the air was injected suddenly at considerable pressure and then there is a fall of blood-pressure before the adrenalin "takes hold." As already shown, the result of air injection under apparently similar circumstances is so variable, that from a relatively small number of experiments, negative conclusions cannot be drawn, but this does not decrease the value of certain definite observations that were made, nor does it preclude using these positive observations as the bases of the certain positive conclusions. Besides the variable amounts of air that could be taken into the venous circulation close to the heart before lethal symptoms resulted, the most interesting observation was the rapidity with which large quantities of air were disposed of after the circulation was once established. Experiment 21, Fig. 11, was started at 11.20 and the heart was clamped at 12 A.M. During this time the dog had aspirated 175 c.c. air through the jugular vein. No air was found in the venæ cavæ; $\frac{1}{3}$ c.c. air was obtained from the right ventricle and a minute bubble from the left. Under water in a bell-jar, no air could be washed from the pulmonary vessels, using water syphoned from a height of two metres. This rapid absorption or elimination of air was demonstrated in a number of experiments.

During these experiments we observed nothing that would verify the conclusions that the depression accompanying air embolism is due to blocking of the pulmonary vessels with air, but the rarity with which traces of air were found on the left side of the heart or were seen in the carotid cannula, even after large quantities of air, 100 c.c. or more, had been rapidly disposed of, leads us to the tentative conclusion that at least a part of the air was either eliminated or absorbed while passing through the pulmonary circulation. (See Experiment 14,—130 c.c. of air had entirely disappeared after 40 minutes.)

It was observed that with an open cannula in the proximal end of the jugular vein, air was aspirated into the vein with the first inspiration, but that almost immediately there was a back

pressure from the leaking heart. If the cannula was left in the vein and the open end inserted into an undistended, thin rubber bag containing a measured quantity of air, it was found that air was aspirated interruptedly (see Experiment 21, Fig. 11).

Based on the observations made during these experiments, we believe that death from air embolism is clinically a rare occurrence, but should grave depression follow the aspiration of air into a vein, the treatment we propose is the introduction of adrenalin chloride in a fairly concentrated solution, 1:10,000 to 1:1000, directly into the right ventricle and that this be accompanied by a small amount of normal saline solution. In our experiments we always used 40 c.c. or more of saline solution, but in most cases a large quantity of air had been put in under pressure and it required a pressure of 60 cm. of water to force the fluid into the vein.

For clinical application a fine hypodermic needle could be pushed through the chest wall directly into the right heart, which could be done by inserting the needle through the chest wall and lung at the anterior extremity of the third or fourth right intercostal spaces. We observed no evil effects in dogs from perforating the heart wall with a fine needle, but to attempt to do it through the chest wall would be a very uncertain procedure.

Air embolism usually results from operations in the neck, in which large veins are exposed. We believe a practical application of this treatment would be to insert a douche point or transfusion needle attached to some sort of transfusion apparatus or douche can containing normal saline. The adrenalin chloride can be introduced into the tube of the douche apparatus close to the vein by piercing it with a hypodermic needle. The water can be put in with probable safety at a pressure of 25 to 30 cm. of water pressure.

In regard to the quantity of a 1:1000 adrenalin solution to be used, we would suggest that 2 c.c. be tried in a severe depression and repeated. In dogs, $\frac{1}{4}$ c.c. was sometimes effective, and the extreme activity resulting from a large dose

was of but a short duration (Experiment 15, Fig. 7, and also 14, Drum 2, Fig. 6) and any dangerous symptoms short of apoplexy arising from an overdose can be modified by bleeding from an artery (Experiment 14, Drum 3, Fig. 1).

Artificial respiration according to the Schafer method should be employed when respiration ceases. As a last resort, the chest might be opened and direct cardiac massage applied (see Experiment 15, Fig. 7). We revived two dogs in this manner after giving the adrenalin. The experiments of Senn show that horses are more severely affected by air embolism in the erect than in the recumbent position, and we advise this position during the effort at resuscitation.

In animals in which the air was forced in under pressure, it was necessary in most cases to apply the remedy within two minutes, but it is probable in many clinical cases in which small quantities of air were aspirated that sufficient time will elapse between the accident and death to allow of some attempt to save them.

The violent contraction of the heart muscle that results from the introduction of a concentrated adrenalin chloride solution into its cavities, is the most efficient agent that we found for restoring a circulation embarrassed by air embolism (see Experiments 4, 1, 3, and 14, Drum 3, Fig. 1).

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PRESERVATION OF THE SUBMAXILLARY BRANCH OF THE FACIAL NERVE IN OPERATIONS ON THE NECK.

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IN considering the permanent results of the operative and non-operative treatment of tubercular cervical lymph-nodes, we must not lose sight of the scars and deformities occasioned by the disease or by surgical interference. Not least among these is paralysis of that branch of the facial nerve which supplies the depressor muscles of the lip. This branch, from its emergence from the parotid gland to its entrance into the depressor muscles, lies in intimate contact with the nodes most frequently involved in the tuberculous process, and is very often pressed on, cut, torn or crushed with a resulting more or less complete and permanent paralysis of the lower lip. This deformity is not inconsiderable, and its avoidance is worth serious attention.

The descending or cervicofacial branch of the facial nerve divides between the lobes of the parotid gland into three main branches,—the transverse, which immediately pierces the mesenteric fascia and supplies the upper or facial portion of the platysma; the descending branch, which leads obliquely downward and forward to become superficial after piercing the deep fascia about the angle of the jaw and supplies the cervical portion of the platysma in conjunction with the superficial branches of the cervical plexus; and the submaxillary branch (*collo-mandibularis* of Jaffé), which remains beneath the superficial layer of the deep fascia during its entire course from the angle of the jaw and beneath the ramus, which it crosses with the facial vessels. The first two branches are of no practical importance, but this submaxillary portion supplies the depressor labii inferioris and the depressor anguli oris, and its injury

results in a paralysis which is very noticeable in smiling, crying, etc. If the nerve is injured beyond repair the paralysis is permanent, as is proven by numerous experiences.

The statement is sometimes made that other branches of the facial or the cervical nerve will compensate for this loss, but this is as unreasonable as to expect a restoration of function in paralysis of the levator palpebræ or following permanent Bell's paralysis, or the paralysis of any given muscle with single nerve supply. Motor nerves are end nerves, so to speak, and do not take up the function of neighboring structures. It is probable that the occasional recoveries from this paralysis are due to a minor degree of trauma primarily, or perhaps to a union of the severed nerve when the ends are favorably placed.

To avoid injuring the nerve, incisions in front of the sternomastoid should always be transverse and at least three-quarters of an inch below the jaw. The deep fascia should be incised freely until the vessels and submaxillary salivary gland are exposed. The nerve clings tightly to the under surface of the superficial layer of the deep fascia, and is usually one-fourth to one-half inch below the jaw. It will be retracted with the upper flap and is safe except in the removal of the nodes above the salivary gland. Here the dissection must be blunt, from within upward and outward, and even with the greatest care the nerve will sometimes be injured. If so, the severed ends should be reunited at once.

The illustrations show fairly well the relations of the nerve to the various structures in the neck, particularly the deep fascia. The author wishes to express his gratitude to Professor Haynes, under whose direction the dissections were made at the Cornell University Medical School, and to Doctor Charles N. Dowd for his advice and encouragement.

FIG 1



Paralysis of depressor labii inferioris (right) and extensive sub-
maxillary dissection

FIG 2



Outline of inferior branches of the facial nerve
dissected or for future reference

FIG. 3.



Submaxillary dissection. Deep fascia incised and retracted, exposing submaxillary branch and the salivary gland in its pocket in the deep fascia.

FIG. 4.



Tubercular submaxillary nodes just beneath the nerve.

FIG. 5.



Platysma turned upward. Deep fascia removed, exposing submaxillary branch and facial vessels, submaxillary nodes and salivary gland. Anastomosis between facial and cervical nerves.

FIG. 6.



Submaxillary branch to depressor muscles, transverse and descending branches to platysma. Deep cervical fascia turned downward.

ANÆSTHOL POISONING CAUSING ACUTE YELLOW ATROPHY OF LIVER AFTER OPERATION FOR ILEOCOLIC INTUSSUSCEPTION.*

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IN the last few years cases of delayed chloroform poisoning have come to our notice from time to time. The main lesion in these cases has been acute yellow atrophy of the liver. In many of them there had been suppurative processes within the peritoneum, thus rendering it uncertain whether these suppurations or the chloroform were the cause of the acute yellow atrophy, inasmuch as that affection has also been observed after operations for intra-abdominal suppurative processes, where ether was used. The case I am about to describe is one in which that element of doubt is eliminated, as there was no suppurative process found at the operation, nor did any develop afterward, as the autopsy showed. This case therefore appears to be an uncomplicated instance of delayed chloroform poisoning.

Oscar S., druggist, aged thirty-six years, was admitted to the German Hospital on December 24, 1909. Three weeks before that date he had been attacked with severe paroxysmal pain in the right iliac fossa together with vomiting and diarrhœa. Appendicitis had been suspected at that time. The symptoms subsided soon and the patient went to work again. After a week or so the paroxysmal colicky pains recurred, but were slightly higher up, about corresponding to the region of the gall-bladder, and a mass was felt under the liver, so that this time cholecystitis was suspected. A day or two later he vomited several times, the vomitus containing biliary matter and at one time blood. The

* Read before the Clinical Society of the German Hospital and Dispensary, December, 1909.

patient became restless and would occasionally scream loudly. When asked, he could give no reason for his shrieking; but from his facial expression it was evident that in his imagination something must have badly frightened him. At this time slight jaundice appeared in his conjunctivæ. He soon became delirious, then stupor set in, and his breath assumed an acetone odor, so that now he had all the characteristic symptoms of acute yellow atrophy. A venesection was now made, followed by saline infusion, but without any effect on his condition. The stupor deepened into coma in which he died on the fourth day. Shortly before death the temperature had risen to 100.

The autopsy revealed an acute fatty degeneration of the liver. The surface of the liver was smooth, the capsule not wrinkled, the cut surface bright yellow with evenly mottled bright red spots; the interstitial tissue was not increased. The peripheral zones of lobules were represented by yellow material. The organ felt greasy and was doughy in consistency. The kidneys showed the signs of acute diffuse nephritis. The portions of intestine at the site of the operation were in good condition. There was no peritonitis with the exception of a slight local patch resulting in an adhesion of the omentum to the ileocolostomy (I had wrapped the omentum around that part, in order to make it adhere). The myocardium was flabby.

It will be seen that in all the characteristic points the history of this case corresponds closely with the histories of other cases of acute yellow atrophy that have been described, the apparent well-being in the first days, followed about the third or fourth day by jaundice, restlessness, delirium, acetone breath, stupor, and coma. In the absence of any suppurative process within the abdomen it is fair to assume that in this case the acute yellow atrophy was due to delayed chloroform poisoning, the deleterious action of the chloroform on the liver being enhanced by a congestion in the portal circulation caused by the intussusception. The existence of such congestion was evidenced by the fact that the patient vomited blood, although there was no lesion in the stomach or duodenum, as the autopsy showed.

The anæsthetic employed in this case was anæsthol, a fluid

stools also contained blood. At the same time the mass in the right hypochondrium was no longer felt, and the existence of a perforation of the gall-bladder into the duodenum was considered as a possibility. The patient improved in a few days and went to work again.

On December 24 he had a severe recurrence of his attack of pain, this time combined with constipation. Physical examination revealed resistance of the recti, more particularly the right. There was tenderness on pressure. A large sausage-shaped mass could be felt extending across the upper part of the abdomen; it seemed to change its shape somewhat with the attacks of pain. As the obstruction was evidently a chronic one, an attempt was made during the next two days to overcome it by high oil and soap enemata, but without avail. On December 27 an operation was performed. An ileocolic intussusception was found extending almost to the splenic flexure of the colon; but the left portion of the colon was drawn over toward the right side, so that the tumor lay more on the right side than on the left. Disinvagination was now proceeded with by gentle manipulations of expression begun at the left portion of the transverse colon and working from there to the right and then downward in the direction of the right iliac fossa. Good progress was made until a portion of the appendix came into view; here the intussusceptum was held firmly within the intussusciens by strong adhesions. By cutting these with the knife the intussusceptum could be released a little more; but then it was seen that the cæcum was partly gangrenous, and the attempt to disinvaginate further was given up. A lateral anastomosis was now made between the ileum and the transverse colon, followed by a resection of the cæcum with half the ascending colon and a small portion of ileum. The cut ends of the intestine were closed by inverting them, two rows of silk sutures being used.

The relief experienced by the patient was immediate; he expressed it by the remark that he felt as though he were in heaven. His temperature at the end of twenty-four hours was 102.8, his pulse 140, respiration 24. From this time on the temperature steadily declined; after forty-eight hours it had reached 99.8 and after that became normal. The pulse, however, remained high, around 120. During all this time the patient felt very well and looked well. In the morning of the third day the

THE SURGICAL ASPECT OF EPULIS AND SARCOMA OF THE JAW.*

BY JOHN SPEESE, M.D.,

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THERE are many conditions of the jaw the pathology of which differs to such an extent that surgical measures must depend necessarily upon the characteristics of the tumors or diseases in question. The relationship which exists between the class of growths termed in a broad sense "epulis" and other more malignant tumors is an important one. In this paper, attention will be directed only to the connective-tissue tumors of the jaw, and those derived from epithelial structures or the conditions due to faulty development of the teeth will not be considered.

The term epulis signifies a tumor springing from the gums, and although the word has been condemned justly because of the confusion its use has entailed, it has become nevertheless so thoroughly a part of the nomenclature of jaw tumors that it cannot be excluded. Probably the greatest difficulty has been experienced in keeping clear the relationship of the highly malignant sarcomata which, springing from the deep tissues of the jaw, pursue a more unfavorable course than the relatively benign sarcomatous epulides. It becomes necessary, therefore, to properly understand such distinctions in order to describe the varieties of epulides and the sarcomata.

Epulis was used originally to describe any tumor which had its origin in the tissues of the alveolar process of the jaws, the term being used independently of the pathologic type of tumor. Thus carcinoma, sarcoma, and various benign tumors,

* Read before the Philadelphia Academy of Surgery, April 4, 1910

the composition of which is about as follows: ethyl chloride 17 per cent., chloroform 35.9 per cent., ether 47.1 per cent.

Eggers (German Hospital "Festschrift") has also published a case of acute yellow atrophy after an operation during which anæsthohol was employed for narcosis. It has long been known that ether is a safer anæsthetic than chloroform. When anæsthohol was brought out, it was believed by some that the danger of chloroform had been removed by this new combination. But we have seen deaths on the operating table where anæsthohol had been given, and the cases reported by Eggers and myself show that one of the remoter results of chloroform poisoning will also not be avoided by using anæsthohol. It seems therefore that, in estimating anæsthetics from the viewpoint of danger, a narcosis with anæsthohol should be considered as being a chloroform narcosis.

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such as myxoma, chondroma, fibroma, etc., were included. The tendency in more recent times has been to describe as an epulis only the sarcomatous and fibromatous tumors originating on the alveolar margin, and to designate the other tumors in this region by their true pathologic name. Because of their less malignant tendency, the sarcomatous forms of epulis are thus properly excluded from other more dangerous forms of sarcoma, but the term "epulis sarcoma" or "epulis fibroma" should be employed rather than simply to use the vague term "epulis." It is particularly desirable to separate from the epulides the carcinomatous type which is occasionally encountered, because it presents altogether a different clinical course from the sarcomatous epulis.

The histologic examination of collected cases of epulis shows a varied picture. Kühner, in his series of 31 cases, found 20 giant-cell sarcomata, 2 spindle-cell sarcomata, 4 fibrosarcomata, 2 fibromata, 1 osteoma, and 1 granuloma. The proportion of giant-cell sarcoma, about two-thirds of all the cases, corresponds to the observations of most writers. Hesse in a recent contribution, however, has disputed these facts, for he found that of 113 cases of epulis, 30 were sarcomatous, and by far the most common form encountered was fibrous in nature. This difference is explained by the fact that the majority of these cases were seen in a dental clinic, where the small and painless tumors are most commonly encountered, whereas the more rapidly growing and consequently more malignant forms are usually referred to the surgical clinics.

Histologically, giant-cells are found in enormous numbers in the majority of cases, the chief constituent of the tumor being composed of spindle- or round-cells. The tumors contain considerable blood pigment and extravasated blood, and at times are quite vascular, thus explaining their brownish-red color. Spicules of bone are common constituents of the growth, a fact which indicates that the bone-forming layer of the periosteum is involved in the growth of the tumor. An epulis occasionally arises from the submucous connective tis-

sues, or in the peripheral layers of the alveolar process, and by growing externally appears beneath the mucosa.

The sarcomatous epulis is a pedunculated tumor, dark red in color, more or less movable, and may cause distortion in the outline of the teeth as it enlarges. The mucosa covering the tumor is intact in the early stages, but sooner or later shows points of erosion due to local traumatism, from which slight hemorrhage may occur. The tumors are usually soft in consistency, but may be firm and hard when of the fibrous or the fibrosarcomatous type.

The statistical studies of Kühner, Gunzert, and others, show a marked predisposition of the female sex, in whom two-thirds of the cases occur. While the disease may be seen at any time of life, it is most commonly encountered in the second, third, and fourth decades, although it is not uncommon in younger and older individuals.

Among the factors chiefly concerned in the etiology of epulis, caries of the teeth may be mentioned as the most prominent. The irritation of ragged, irregular, diseased teeth plays an important rôle in the formation of these growths, and such a history will be obtained from the majority of patients. In the instances in which extraction of a diseased tooth has been followed by the formation of a tumor, it is likely that the traumatism was sufficient to cause active growth of cells left behind after the removal of the tooth. This is especially likely when we bear in mind the tendency of the tissues of the mouth, the mucosa and the periosteum of the alveolar process to react to any sort of irritation. It should be mentioned, however, that epulides occur in the presence of sound teeth and under proper oral hygiene, neglect of which seems to act as a predisposition to the formation of the tumors. The influence of pregnancy in the development of an epulis has been repeatedly mentioned; the association, while difficult to explain, seems to be more than a mere coincidence. Finally the effect of artificial teeth, the irritation of pipe smoking, and other forms of long-continued traumatism may be mentioned as possibly having some etiological importance.

Clinically the tumors rarely cause serious symptoms. The jaw may be infiltrated in the late stages of the disease and absorption of the cortex arise; it may extend to the antrum or nasal cavities, displace the tongue, or cause protrusion of the lips. In the very large tumors, difficulty in chewing, swallowing, and speaking may be caused. Pain, which at times is complained of, is due to the diseased condition of the teeth. Repeated traumatism may cause hemorrhage from the more vascular growths, which in time may cause a moderate degree of anæmia. The ulcerative condition of the gingival mucosa may play a rôle in causing more rapid enlargement of the epulis.

The benignancy of this class of neoplasm is well demonstrated by the fact that metastasis to the regional lymph-nodes occurs practically in advanced cases only. The enlarged nodes seen in the course of an epulis are usually of inflammatory origin, and are caused by infection absorbed from carious teeth. In many instances the nodes disappear after extirpation of the tumor, and in those cases in which the enlarged lymphatics were removed with the tumor, microscopic examination has failed to reveal malignancy in the nodes.

The tumor generally exists for a considerable period before operative intervention is carried out; in most instances a year or more may elapse until rapid enlargement of the epulis causes the patient to seek surgical aid. Perthes is inclined to place little weight in the view that the giant-cell tumors are less rapid in their growth, because he has observed cases of the same histologic character, in which marked difference in rapidity of the enlargement has been present.

It is a well-known fact, that whereas epulis is a tumor benign in nature from the clinical stand-point, it tends to recur when insufficiently removed, and in such cases the recurrent tumor may take on a more rapid growth. Kühner records 11 recurrences in 90 cases of epulis—the operation in this series removed only the visible tumor tissue and not the portion of the alveolar process from which it sprang. If secondary operations are carried out promptly, the chance of ultimate

cure is good, for instances are on record in which repeated operations have finally resulted in a cure.

That the prognosis is good is shown in the very large percentage of cures which ranges from 75 to 97 per cent. An important observation was carried out by Kühner in four of the cases not undergoing operation for the radical removal of the epulis. He found that three died from the effect of the tumor, one of general sarcomatosis; the second, a man fifty-four years of age, of extensive recurrence; and the third, a male aged sixty-six, from blood poisoning originating in the epulis. In the fourth case, a boy aged five, spontaneous healing occurred and persisted for a period of 25 years. From these cases and similar observations, it is apparent that epulis, if neglected, may become highly malignant, and resemble in this particular the sarcomatous growths of the jaw.

Fibroma.—This affection appears as a central growth, or it may arise from the periosteum and appear as an epulis of the fibrous type. The growth has many of the characteristics of the sarcomatous epulis, but appears harder and more compact, owing to the large amount of fibrous tissue in its structure, which accounts for its lighter color. In some instances the cells of the tumor are so abundant that the growth is quite soft, resembling a sarcomatous epulis for which it is mistaken at times. Eve holds the opinion that most of the so-called fibrous epulides are sarcomata, for in his series of cases a pure fibrous epulis did not exist. This, however, does not correspond with other observations; I have studied two cases in which there was no evidence of sarcomatous tissue in growths which were classified as fibrous epulides. Gunzert described myxomatous degeneration of the tissues which is particularly prone to arise in the tumors of long standing. The base of the epulis may contain lime salts or spicules of bone. While the tumors are usually small, they at times reach a large size and are dangerous from a mechanical stand-point. Sudden enlargement is indicative of a malignant degeneration, i.e., sarcoma. Perthes calls attention to the tendency of the fibrous epulis to appear as multiple growths affecting both jaws.

The central variety of fibroma differs as greatly from the fibrous epulis as does sarcoma from a sarcomatous epulis. The growth, according to Perthes, may occur in either jaw, but is more common in the lower. The tumor takes its origin from the central part of the bone, and as it grows the periosteum and cortex become expanded over it, forming a thin shell, or the rapidly growing tumor may be covered with a layer of tissue containing bone trabeculæ derived from the periosteum. The tumor may be firmly attached to the bone covering it or lie free in the cavity. When seen in the upper jaw, the tumor tends to spread toward the antrum, or may arise primarily in that situation.

The growth of a fibrous epulis is essentially a slow one, it may occupy many years in its development, and most commonly occurs in the third and fourth decades of life. The enlargement does not, as a rule, produce pain unless pressure is exerted upon nerves, as, for example, infra-orbital neuralgia may occur in the fibromata of the upper jaw. There is no tendency of the tumors to metastasize, ulcerate, or infiltrate the surrounding tissues, all of which point to its benign nature. Secondary infection and necrosis have followed exploratory incision in a fatal case recorded by Heath.

The diagnosis depends largely upon the gradual growth and painless course of the fibroma. If the tumor is attached to the lower jaw, distending it, and if surrounded by a shell of bone, the differential diagnosis between it and other benign growths will be difficult, and may only be made by aid of a Röntgen examination. The differential diagnosis may also be difficult in slowly growing myxosarcomas in the same location.

The operative measures in these cases demand complete removal of the tumor and the portion of bone to which it is attached. Only in exceptional cases will it be necessary to do total resection, and then only when the size of the growth prevents less radical measures. Following partial resection of the jaw and the tumor, the results have been satisfactory, since the benign nature of the fibroma excludes the possibility of a recurrence.

Sarcoma.—Sarcoma of the jaw occurs less frequently than carcinoma, the proportion being about two cases to the former to three of the latter. The relative frequency of sarcoma of the jaw is shown by Gurlt's statistics in which 14,630 tumors included 532 growths of the jaw, and of the latter 179 were sarcomata, 96 occurring in the upper jaw and 63 in the lower. From these statistics and other observations, the upper jaw is found to be the more common site of the tumor. As already noted in the sarcomatous epulis, the female sex is more often affected; the same relative proportion is observed in the jaw sarcoma. In Perthes's collected statistics of 126 cases, 55 were men and 71 were women.

Trauma seems to play an important rôle in the etiology of sarcoma. Whether the effect of injury is manifested by the stimulation of tumor cells already present, or whether the trauma is even more intimately concerned in the origin of the growth, is difficult to prove. The cases which I have studied show in several instances that trauma played a part in the development of the tumor. In one instance a very large sarcoma began its initial growth several months after the extraction of two teeth and reached its maximum size in eight years. It is possible in this case that the effect of trauma was manifested by increased rapidity in growth of cells, which were present at the site of the diseased teeth, but which were more or less inactive previous to the traumatism. In another instance, a boy aged twenty-two was injured while boxing, and several of the lower teeth were loosened. After this accident tenderness was present for several months, and then swelling of the jaw arose. This condition lasted for three years, when rapid enlargement took place, so that four years after his accident a definite mass the size of a hickory-nut projected from the middle of the ramus of the lower jaw. This tumor and the adjacent portion of the jaw were removed by Dr. C. H. Frazier, and on microscopic examination was found to be an osteosarcoma of a low degree of malignancy.

Histologically all varieties of sarcoma occur and follow the general rule that the smaller and more abundant the cells,

in that the shape of the growth varies, it takes its origin directly from the periosteal covering of the jaw, a fact easily demonstrable on palpation. In the early stages the mucosa is intact, the growth is painless until it undergoes ulceration or the infiltration of the bone causes pain. Pain is also seen in the neoplasms which press upon nerves. Neuralgic conditions of the teeth may arise and direct attention to the cause, a beginning sarcoma.

The operative indications of jaw sarcomata depend on the histologic type of tumor and the extent of the growth. Perthes's statistics based upon the results obtained in several clinics lead us to conclude that, after a period of three years, a third of the cases of total resection of the jaw for sarcoma will remain well. One-half of the patients develop recurrence, a fact which demands still more radical measures in treating these cases. It must be stated, however, that partial resection of the jaw has met with considerable success, but too great emphasis cannot be laid upon the class of cases for which this operation is indicated. The small, well-circumscribed, giant-cell sarcomata situated on the alveolar margin of the upper jaw, irrespective of epulis, and sarcoma of the hard palate may be partially resected. Similar growths on the alveolar process of the lower jaw may be treated in the same way, but all other forms of sarcoma should be subjected to total resection. The percentage of cures in these cases will increase if we operate at an earlier period, before the growth has involved a large area of the bone. The slight tendency toward regional or general metastasis should prove of great value in favoring early operation, and markedly assist in cure because of the lessened possibility of recurrence.

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THE USE OF DIFFERENTIAL PRESSURE IN THE TREATMENT OF EMPYEMA.*

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As the bar to progress in thoracic surgery has been the danger of lung collapse, clinical advance in this field has awaited the invention of a certain and practical means of preventing pneumothorax. This difficulty is now overcome,

FIG. 1.

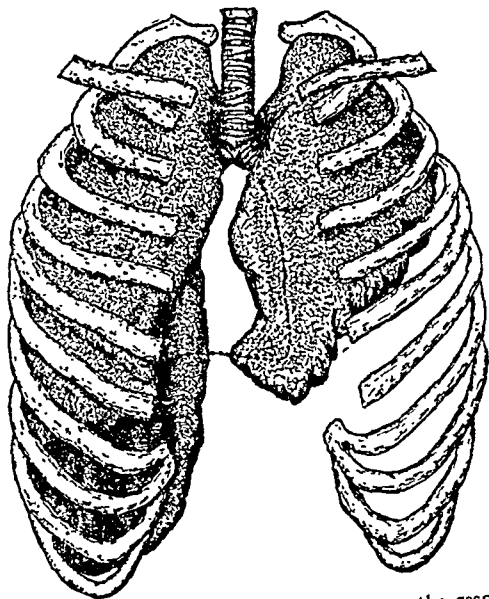


Diagram showing pressure effects of pleuritic effusion upon the respiratory viscera and mediastinal structures.

and there are already well-recognized procedures in which the use of differential pressure is a necessary part of the technic. Among such, one might mention the removal of tumors of the thoracic wall, pleura, and lung; exploration of the pleural cavity for foreign bodies; excision of the whole or part of a lobe for bronchiectasis; and gastro-æso-phagostomy for malignant disease of the cardia or benign or malignant stricture of

* Read before the Canadian Medical Association at Toronto, June, 1910.

the lower extremity of the œsophagus. The widest field, however, for the application of differential pressure is found in the treatment of empyema, where, by its means and by the application of a suitable dressing after thoracotomy, the period of disability may be very greatly curtailed. At the time of operation and at subsequent dressings, positive differential is especially suitable, as with a portable apparatus not only hospital cases but also cases operated upon in private homes may enjoy the benefit of this method of treatment.

FIG. 2.

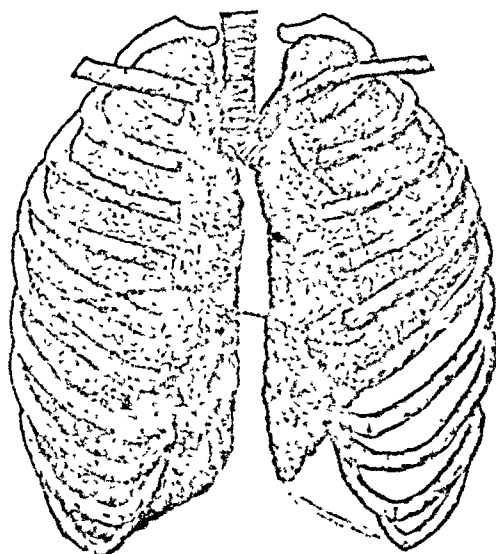
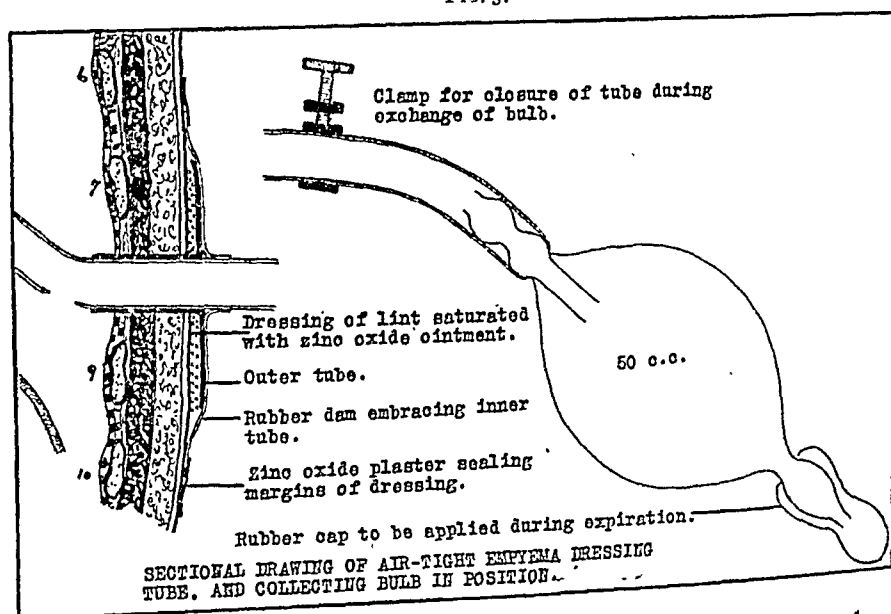


Diagram showing correction of alignment of mediastinum after removal of normal contour of lung on the unaffected side under differential pressure and in the presence of thoracotomy. The lung on the affected side also shows a slight increase in volume.

The accompanying illustrations convey graphically the effects of differential pressure in the treatment of empyema (Figs. 1 and 2). Following thoracotomy an empyemic cavity remains exposed to atmospheric pressure. In extensive cases the whole lung may be collapsed and may lie in close apposition with the mediastinum. Further, the mediastinum and pericardium are not infrequently displaced toward the sound lung. Under such conditions, each inspiratory act results in the deflection of the mediastinal septum and collapsed lung toward the sound side, in response to the negative tension produced on that side during inspiration. On consideration, it is quite cor-

dent that the mediastinum and exposed viscera must tend to move away from the cavity so long as the tension within the cavity remains greater than the average intrapulmonic tension. This fact partially explains why, in long-standing cases, the collapsed lung fails to regain to any extent its functional activity. In these cases the empyemic cavity is eventually obliterated by the formation of scar tissue within, and through its contraction, the approximation of the various anatomical structures forming the boundaries of the cavity, that is the mediastinum, the diaphragm, and the chest wall. We are all

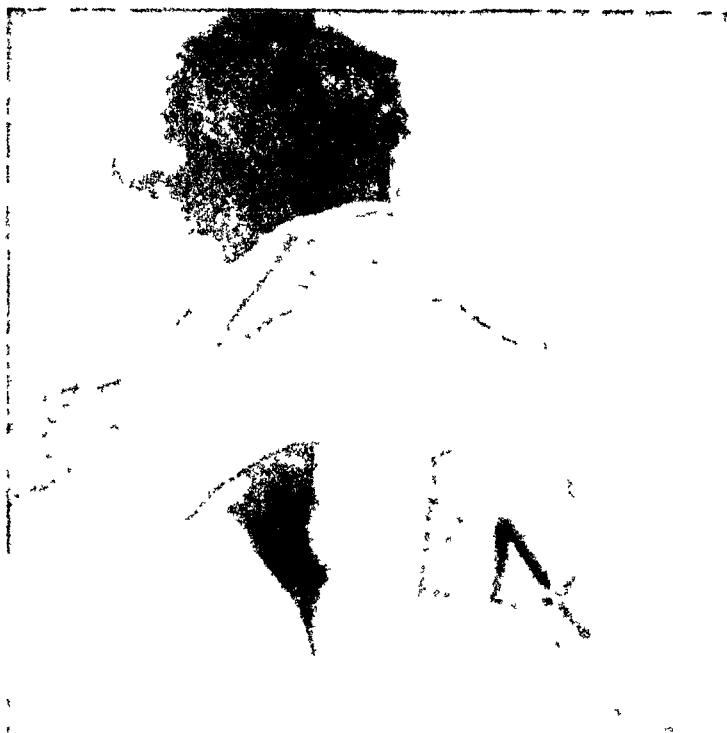
FIG. 3.



familiar with the resulting deformity. In the fact that the mediastinum tends to oscillate towards the sound lung during inspiration, we have the explanation of the cyanosis and rapid respiration so frequently present after thoracotomy for empyema. An inspiratory deflection of the mediastinum toward the sound lung must necessarily nullify, in direct proportion to its degree, the end result of inspiration by lessening the area and amplitude of infundibular inflation.

With the use of differential pressure and the application of an air-tight dressing, such as the one which I have devised (Figs. 3 and 4), not only is the mediastinal deflection reduced

Fig. 4





and the cavity thereby diminished in size, but the air within the abscess cavity becomes negative in tension during inspiration, and, in consequence, the mediastinum and pericardium tend to be further deflected toward the cavity and the collapsed lung to expand in the same direction. An immediate result of such a method of treatment is the prompt relief of the cyanosis. Subsequently, day by day, there is an appreciable diminution in the size of the cavity. Not only does this dressing do away with the foul odor in the sick room, but as will be seen by the chart, the amount of discharge may be accurately tabulated.

FIG. 5.

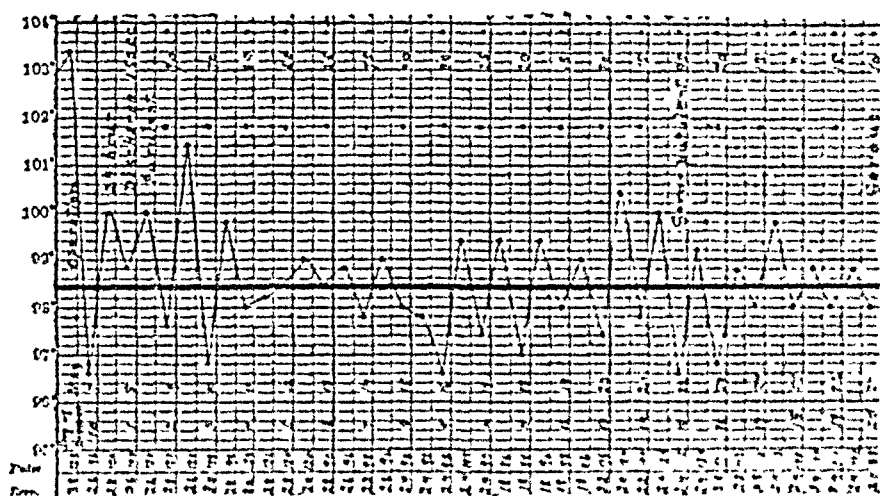


Chart from case (Fig. 4) of pyopneumothorax, showing the daily amount of discharge.

The collecting bulb in this way becomes an instrument of precision. If the discharge shows a gradual decrease and the temperature remains normal, one may be satisfied that there is no pocketing or retention of pus. On the other hand, if there is a rise in the temperature curve, a definite knowledge of what the amount of the discharge should be may give one a clue to the cause. Apart from the curtailment of the period of disability, the absence of odor and of the pain and discomfort of prolonged dressings, the earlier restoration of the collapsed lung to its normal respiratory activity may remove to a large extent the danger of a subsequent tuberculous infection.

PRIMARY SARCOMA OF THE STOMACH.

WITH REPORT OF TWO CASES.

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AND

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THE interest of these two cases centres, first, in the fact that they are examples of a comparatively rare type of disease; second, that they presented symptoms of marked disagreement; and, third, that neither gave indications sufficiently suggestive of the pathological lesions existent. Without further comment, the history of each case will be first given.

CASE I.—Miss A. P., aged fifty-seven years, a teacher by profession, was seen in consultation with a local practitioner. The case was considered probably one of a large ovarian cyst, and the patient was accordingly removed to a private nursing home for operation. She was admitted in October, 1909. She had always enjoyed good health, and with the exception that she had recently suffered from occasional attacks of frequency of micturition, her only complaint was one of increasing discomfort from enlargement of the abdomen. She was perfectly clear and emphatic regarding the entire absence of any gastric symptoms, and being a particularly intelligent lady such a statement may be regarded as possessing the truth. Menstruation had ceased two years previously. Prior to that her periods had been regular and normal, accompanied only with some pain on the first day. Since the menopause there had been no symptoms referable to the uterus. Her previous history was free from any disturbances of a local or constitutional character. The lower part of the abdomen was very prominent, and a large swelling could be felt filling the hypogastric and

lower umbilical regions with a leaning towards the right flank. The tumor felt quite smooth on the surface and appeared movable. There was no indication of fluctuation. Pressure caused no pain, nor from the regularity of her bowels did it seem to have any obstructive effect upon the intestines. Both flanks were resonant. An examination *per vaginam* revealed a small but freely movable uterus; both fornices were empty, and the tumor seemed to be entirely without the pelvic cavity.

The abdomen was opened by a curved incision below the umbilicus. A smooth rounded tumor was at once encountered presenting a somewhat dark mottled and striped appearance. The hand introduced into the abdomen felt a nodular projection at the upper part, with attachments below to the omentum and above to the stomach. The growth was felt to be free from any connections with the pelvic viscera. A small median incision carried upwards permitted the tumor to be brought out. After tying off the few omental adhesions, the growth was then discovered to be united by a solid pedicle, about the diameter of the thumb, to the greater curvature of the stomach some two inches or so from the pylorus. The part of the gastric parietes involved was excised, and the aperture closed by a double row of sutures. The patient made an uninterrupted recovery.

The specimen when examined after removal was found to be a large unilocular cystic tumor with smooth external wall, and filled with laminated clot. It measured $14 \times 14 \times 11\frac{1}{2}$ cm., and was adherent to the wall of the stomach. A portion of the stomach wall with tumor tissue invading it, of the size of a walnut, was also submitted for examination, and on section presented a somewhat gelatinous appearance with healthy-looking mucosa covering it. Section of the wall of the cyst showed, under a low power, a fibrous stroma supporting a cellular element. In parts of the section the structure was of a somewhat loose character; in others more dense and cellular. At the periphery the fibrous character was more apparent, and the outer part of the tumor area had an appearance not unlike that of a spindle-celled sarcoma. In the central part of the section thin-walled congested vessels were fairly abundant, and extravasations of red blood-corpuscles were also apparent. Spaces resembling fat cells were also seen in the section. With the high power the characters of the cells which composed the tumor

were found to fall into two groups—cells of connective-tissue origin, fibroplastic and definitely spindle in shape; and larger cells of spherical shape with sharply staining nucleus and a large protoplasmic body deficient in chromatin. Well-formed blood-vessels were present in the section, and in a few places small nodules of lymphoid cells were also present. The characters of the section would suggest a tumor of mesoblastic origin, viz., a mesothelioma. Microscopic examination of the stomach wall showed that the mucous membrane and submucous layers were unaffected by the tumor involvement, but the muscular wall showed extensive infiltration. Areas of tumor cells extended between the muscular bundles, and in parts replaced them. Under the high power the same character of cells was noticed as above described in the cyst wall, but the larger spherical cells were more abundant.

CASE II.—R. H., aged sixty-three years, was admitted to the Victoria Infirmary in July, 1903, suffering from a tuberculous stricture of the rectum. At this time there were no gastric symptoms, his trouble being entirely referable to the rectum. The stricture was successfully excised, and he remained well for some years. He then began to be troubled with prolapse of the rectum and some incontinence of fæces. For this he was again admitted to the Infirmary in September, 1909, *i.e.*, six years after his first admission. During this period of residence he complained of very distinct gastric symptoms—he had a distaste for food and felt occasional pain in the epigastrium; the latter, however, seemed to have no association with the ingestion of food. He did not vomit, nor did he feel any inclination to do so. There was no tenderness in palpating the epigastrium, nor could anything be felt; he was, however, quite definite and positive in his statement that a lump occasionally appeared on the “left side of his belly” just below the costal margin. As the condition of the bowel was solely under consideration, the gastric symptoms did not receive the amount of attention they deserved. He was in a very low and enfeebled state of health, and succumbed after the operation attempted to relieve the prolapse. A postmortem was obtained, when the following conditions in connection with the stomach were found:

Adherent to the stomach was a large cystic tumor, somewhat larger in size than a child's head, springing from the greater

curvature of the stomach, with smooth external wall, unilocular, filled with blood-stained fluid, and soft tumor tissue resembling in appearance partly organized blood-clot. The mucosa was healthy. The microscopical examination of the tumor showed its character to be that of a spindle-celled sarcoma, fairly dense in consistency. Throughout the section were noted a number of new-formed thin-walled vessels filled with blood, and in parts extravasations of blood were seen. The section through the stomach wall showed tumor infiltration of the serous and muscular coats. The mucosa was found uninvolved. There were no evidences of tumor formation in any other part of the body.

Remarks by Mr. Maylard.—Primary sarcoma of the stomach, as judged by recorded cases, seems a very rare disease, and more particularly so if the pyloric region be excluded. In other words, cases such as those just described, of well-defined and distinct non-ulcerative growths springing from the mid-gastric parietes, are extremely exceptional. Probably one of the earliest recorded cases, or, at least, one of the earliest successful cases of removal of a tumor of this nature from the stomach, is that of Billroth's in 1881. Since then isolated cases have from time to time been reported, and if foreign records be excluded, very few have been published in the English language. In the past they appear to have been more frequently met with in the post-mortem room than in the operating theatre; and a really correct appreciation of the frequency of the disease, therefore, could only be obtained by a combined investigation of surgical and pathological records. There are two published cases which I will refer to more particularly, because in certain points they markedly resemble my own. In one, recorded by Hartley (*ANNALS OF SURGERY*, vol. xxiii, 1896, p. 609), the tumor was a spindle-celled sarcoma, like, therefore, my second case. In the other, recorded by Cantwell (*ANNALS OF SURGERY*, vol. xxx, 1899, p. 596), the clinical resemblance to my first case was most striking; in neither were there any symptoms attributable to the stomach, indeed, the sole complaint made by each was the increasing discomfort engendered by the abdominal distention. Strangely, also, a

further agreement existed in the fact that in both instances it was thought likely that the tumor was connected with the genital organs. I must own that no other thought entered my head; for although a vaginal examination showed the pelvic organs free, it simply left the impression that the supposed ovarian cystoma had swung itself free of the cavity of the pelvis. We were further misled by the patient's statement that she first noticed the swelling in the right flank. It must be deemed a remarkable fact, as much in my own case as in that of Cantwell's, that such large tumors could hang from the gastric parietes without interfering with the normal functions of the viscus and causing some sort of dyspeptic symptoms.

Remarks by Dr. Anderson.—Both the tumors presented a marked similarity in their external appearances, being cystic in character and covered by a smooth external peritoneal lining, and both springing by a definite pedicle from the wall of the stomach, the mucosa of which in both cases was uninvolved. The second case presented the definite microscopical appearances of a spindle-celled sarcoma; the first case, on the other hand, showed the presence of characters of a spindle-celled sarcoma and endothelioma in different parts. The following quotation from a paper upon the subject by MacCormick and Welsh (*Australasian Medical Gazette*, July 20, 1906) is of interest. These authors state: "It is sometimes hard to decide whether the growth has started in the stomach or has taken its origin in some adjacent structure. In the case of the spindle-celled sarcomata, they rarely present this difficulty of interpretation, and their origin in the submucosa is more generally accepted. They commonly take the form of localized growths which sooner or later project from the outer surface of the stomach, and when, as so often happens, they grow from the posterior wall, they pass into the lesser sac of the peritoneum, which they may come to distend. As they increase in size, they frequently become pedunculated and may form adhesions to adjacent structures."

It is in connection with the first case, in which both spindle

and endothelial cells are present, that the difficulty arises. I described it in the account of one section as a mesothelioma, and from this I infer that it had its origin in or beneath the serous coat. Similar difficulties in reviewing the tumors of the round-celled sarcomata group have been experienced by the above-named authors; but here the question was whether the case was a primary sarcoma or secondary infiltration of the stomach wall of the nature of that seen in lymphocythemia. But the clinical history and present satisfactory condition of the patient are more in favor of the opinion I have expressed.

THE FUNCTION OF THE APPENDIX AND THE ORIGIN OF APPENDICITIS.

BY EDRED M. CORNER, M.C., F.R.C.S.,
OF LONDON,

Surgeon to the Children's Hospital, Great Ormond Street; and to Saint Thomas's Hospital, in Charge of the Surgical Isolation Wards and Outpatients.

SHORTLY after his death, a paper was published in the *ANNALS OF SURGERY* by Mr. C. B. Keetley about the function and value of the appendix. Both he and Sir William Macewen regard the appendix as a valuable actively useful organ not to be sacrificed lightly. Their opinions are based largely upon complicated clinical observations. Other observers, such as Mr. W. J. Mayo, incline to the other extreme: that the value and functions of the appendix are so small that they are absolutely inconsiderable when compared to the dangers which it may cause. When the enormous number of people are considered who have had their appendices removed and are in perfect health, one cannot but sympathize with the latter view put forward. Yet as a matter of scientific interest, the appendix has a function; and, when diseased and removed, that function is undertaken by neighboring tissue and the patient is relieved of a passive tube containing actively poisonous material. Such a view I advocated in the Erasmus Wilson Lectures delivered before the Royal College of Surgeons in 1904¹ and, in view of Mr. Keetley's recent death, shall content myself with restating them. This is done in four sections: the natural history of the ileocæcal region, the physiology of the appendix, the development of the appendix, and the pathology of chronic typhlitis and appendicitis.

THE NATURAL HISTORY OF THE ILEOCÆCAL REGION.

Food in the mouth is reduced by the action of the teeth to a more or less pulpy condition, in which state it enters the

¹ "Clinical and Pathological Observations in Acute Abdominal Disease" (Constable & Co.), 1904.

stomach, where it is further broken into fragments by the action of the hydrochloric acid, pepsin, and churning muscular movements. The casein of our primitive natural food, milk, is precipitated and also fragmented. The pylorus, the smallest portion of the alimentary canal, allows or should allow no large pieces to pass into the duodenum. The work of the stomach and mouth may be regarded as chiefly, if not entirely, preparatory to chemical digestion and absorption, and to partake of the physical nature of fragmentating the food. The more perfect the work of the stomach, the more completely will the food be reduced to a molecular condition, and consequently, the more perfectly will it be adapted for the chemical action of the bile and pancreatic secretions. The next twenty odd feet of the small intestine are given over to these chemical changes and the absorption of nutriment. The products of digestion having reached the ileocaecal valve, it is the duty of that sphincter only to allow water, soluble material, and very small pieces of indigestible debris to enter the caecum. There are similarities in the physiologies, *i.e.*, homologies, between the pylorus and the ileocaecal valve. The former is the portal between fragmentation on the one hand and chemical digestion on the other; the latter stands between chemical digestion and specialized absorption on the one hand, and possibly excretion, and the absorption of water on the other.

Fluid or semifluid material is passed from the small intestine through the ileocaecal valve into the caecum. The latter is not adapted for the carriage of fluid by peristalsis; it is too large and thin walled to contract efficiently, unless it is tightly distended like the bulb of a Higginson's syringe. In addition, in man, gravity works against it. As a result the faeces must remain in the caecum until the absorption of water from them and the addition of mucus to them have rendered them of the proper consistency for their transit along the large intestine. Hence, it is easy to understand why the caecum is so often the most capacious part of the large bowel, and why at operations, particularly for intestinal obstruction, surgeons so frequently find it distended out of all proportion to the rest of the alimentary canal, the bowels being full of fluid.

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Hence, just as there is a natural pause for food in the stomach, so is there another for the products of digestion in the cæcum; and in both, the contents are prepared for their course in the next part of the alimentary tract. To turn to the pathological significance of this halt, pause, or rest, it will be seen at once that the cæcum is the breeding ground of bacteria, par excellence, of all parts of our intestine. The enumerations of the colonies from different parts of the alimentary tract bear this out, and have proved that colonies of bacteria are more frequent by hundreds and thousands here than in any other part of the intestinal tract, even after a period of starvation. And it is only to be expected that this difference will show manifold increase when food is taken. It is now very easy to understand why nature has established so large a storehouse of protective lymphoid tissue for the production of leucocytes in the ileocæcal region, to which the appendix is an intestinal "tonsil," an index of the fermentative processes which are going on within the cæcum, a culture tube for the bacteria therein contained. Hence the very great frequency of its inflammation—appendicitis.

It will now be seen that there is strife between the micro-organisms and lymphoid tissue in the cæca of every one. Hence the gradual disappearance of the lymphoid tissue as age advances. If the strife becomes a little more severe than it is ordinarily in health, some inflammation about the ileocæcal region will result, as after a dietetic indiscretion. In the great majority of cases, this inflammation shows itself as appendicitis. In consequence, appendicitis may be regarded as a result of the exaggeration of a process natural to the ileocæcal region of all.

THE PHYSIOLOGY OF THE APPENDIX.

It has long been taught that this organ was functionless, and that most probably in this lay its apparent incapability to resist the attacks of disease. That it represents the terminal portion of the cæcum which has become differentiated in development is undeniable, but that it is functionless is undoubt-

edly untrue. Like the rest of the intestinal mucous membrane, that of the appendix has numerous glands whose secretion has apparently an insignificant digestive action on all foods. As little if any contents of the cæcum ever enter the appendix, any digestive action it has must be of the smallest, and its absorption of products of digestion cannot be greater.

To sum up this phase of intestinal physiology: in the small intestine the products of digestion are fluid and are being continuously passed onwards by peristalsis; the cæcum is the first great "resting place" for these products since they have left the stomach; the large intestine, as its name implies, is of greater calibre than the small and is more suited for the carriage by peristalsis of solid than liquid feces; the cæcum being rendered less mobile owing to its peritoneal attachments and, in man, having to work semifluid material against gravity, the products of digestion have to remain in it until their consistence has become such as allows of their passage along the large intestine; the change in consistence is made by the deposit of mucus from the glands of the large intestine and by the absorption of water. In consequence, the cæcum of the child loses its tapering form and becomes larger by the development of pouches between the *tæniæ muscularis*. During this "pause" further quantities of digested material will be deposited in the cæcum and dilate that structure, possibly delaying the despatch of the first "fecal" contribution. Hand in hand with these processes will go the fermentative changes of myriads of micro-organisms, to whom the temporary stagnation offers opportunity of multiplication. Hence the far greater quantity of bacteria in the large than in the small intestine. The temporary delay in the passage of the intestinal contents, the absence of a secretion like that of the stomach, the presence of large quantities of active micro-organisms and their products point to the necessity for the development of a protective armament on the part of the host to counteract them. Hence the large development of lymphoid tissue in the terminal and most dependent part of the cæcum, *i.e.*, the appendix, and its specialization not degeneration. The need

of the presence of this "intestinal tonsil" is apparent in the cæcal region. The comparative absence of lymphoid tissue in the rest of the large intestine is explicable, as it is in the cæcum that the fæces have been brought up to the proper consistence to allow of their passage along the colon, and in consequence there are no more prolonged periods of "rest" in the presence of moisture, the fæces becoming dryer and harder; consequently there will be less fermentative action.

Hence it may be said that: (a) Lymphoid tissue is the characteristic feature of the cæcal apex. The vermiform appendix of man is represented in the vertebrate kingdom by a mass of lymphoid tissue, situated most frequently at the cæcal apex. (b) As the vertebrate scale is ascended, this lymphoid tissue tends to be collected together into a specially differentiated portion of the intestinal canal, the vermiform appendix. (c) The vermiform appendix of man is not, therefore, solely a vestigial structure, though it undoubtedly represents the terminal part of the cæcum. On the contrary, it is a specialized part of the alimentary canal, nature having made use of a disappearing structure and endowed it with a secondary function by giving it lymphoid tissue to protect the body against the micro-organisms in the ileocæcal region.

DEVELOPMENT AND LIFE HISTORY OF THE APPENDIX.

The development of this organ illustrates the previous contentions and can be studied both in the individual, ontogeny, and in the animal series, phylogeny. That of the human foetus will be given first.

Up to the third month of intra-uterine life the diverticulum of the primitive intestine, which subsequently becomes the cæcum, is of uniform calibre throughout. At this period its growth becomes unequal, the terminal portion failing to increase in size at the same rate as the proximal. The inequality thus established becomes more and more marked as time goes on. At birth the terminal part of the cæcum, or the appendix as it is called, forms a tapering prolongation of the cæcal diverticulum.² It is not until later that a definite line of

² Keith, "Human Development and Morphology."

demarcation is to be seen between the two structures. The fetal type of cæcum is, therefore, an inverted cone whose apex imperceptibly shades off into a prolongation of the appendix. It will now be seen that the appendix represents the terminal portion of the original cæcum.

Turning to the animal series for suggestions to aid in the explanation of this phenomenon, it is found that a distinct appendix is only seen in man, anthropoid apes, lemurs, and the opossum. On the other hand, it is common to find a lymphoid structure at the distal portion of the cæcum, which undoubtedly represents the appendix.³ In the latter series of examples, the cæcum and its lymphoid appendage conform to the human fetal type. It is quite a later phase both in ontogeny and phyllogeny that the cæcum loses its conical form by the development of pouches between its three thin muscular bands. And it is by that that the appendix becomes distinctly separated.

As age advances the appendix undergoes changes both in position and structure. In the fœtus it is situated along with the cæcum under the liver, and later it descends into the iliac fossa. Sometimes it remains in its fetal position, or it may be arrested at any part of its descent. An examination of the appendices for different decades shows that they are both relatively and absolutely longest and thickest between the ages of ten and thirty. The walls during this same period are stuffed with lymphoid nodules. After the latter age the appendix begins to undergo a slow involution both in length and thickness. The lymphoid nodules disappear also, though more slowly and uncertainly.

Robert Morris⁴ has directed attention to the association of pain, intestinal, and general symptoms with this involution. The change is certainly of a chronic inflammatory character such as would be expected to occur in nearly every one who has an appendix, and is the result of the continued irritative

³Morris, *Am. Journ. of Obstetrics and Gynecology*, 1901, 432

⁴Berry, *Journal of Anat. and Phys.*, 1910

action of bacteria throughout years. Still more recently the occurrence of appendix-dyspepsia (its more modern name) has been rediscovered.

PATHOLOGY OF CHRONIC TYPHLITIS AND APPENDICITIS.

It is a matter of more or less common knowledge that, as years pass, changes are found in the appendices of people who have never had a clinically recognizable attack of appendicitis. How much of these changes are physiological it is impossible to decide; and in this connection it is not so important, because, whatever they are, they will interfere with the normal performance of the work of the appendix, and so lead to evil results. One of the best known of the changes is the disappearance of the lymphoid follicles that are so plentiful in early life. Is this disappearance pathological or physiological? Yet if sections are cut of appendices removed from people over sixty, or even older, these follicles sometimes can be found in abundance. The persistence in these cases may be due to individual variations in the rate of aging; or perhaps more probably, they indicate that the disappearance is of more pathological than physiological import.

In considering the physiology of the appendix, it has been shown that the cæcum is the first great place of rest or stasis for the products of digestion after they have left the stomach, consequently the appendix is a tube which serves as an index to the chemical and bacteriological processes which occurred there. One well-known property of lymphoid tissue is that its constituents are actively protective to the organism against foreign invaders. Situated in a blind tube in whose lumen are represented types of the organisms of the large bowel and their fermentations, the lymphoid follicles must have a great deal of work to do, more even than the tonsils, to which the appendix has been compared. It is well known that the tonsils undergo fibrosis or chronic inflammation without the occurrence of an acute attack. In a like manner do similar changes occur in the appendix, but unfortunately there is a very marked difference. Fibrosis of the appendix interferes with

the efficiency of its peristaltic action, and the tube becomes incapable of emptying itself. By these means a vicious circle is established, as the more material (pabulum) which remains the more will bacteria flourish, and the more likely is it that the chronic inflammation will progress, and the organ become still more incapable of performing its own evacuation. Such a condition may be aptly called appendicular constipation. The inspissation of the contents will lead to the formation of an appendicular calculus of fecal concretion, which may be likened to scybala elsewhere in the large intestine. It may be assumed that the presence of concretions indicates the existence of pathological change. And their association with chronic inflammation explains the fact that they are frequently found by the surgeon and the pathologist in cases which have never had a clinically recognized attack of appendicitis.

The result of chronic appendicitis may be at times far more extensive than this. The fibrosis with its subsequent contraction leads to further disappearance of the lymphoid follicles and impairment of the muscular action. The appendix consequently becomes an inert breeding ground for micro-organisms, and if they escape into the cæcum the multiplication is continued there. The cæcum will be affected sooner or later by the continued escape into it of toxic material elaborated in the appendix, and, as it is necessary that the products of digestion remain there until they are of suitable consistency to be passed on into the ascending colon, those toxic materials will become still further elaborated and give rise to chronic typhilitis. Again there is the vicious circle, as the inflammatory condition will impair the contractile power of the cæcum, and so lead to further bacterial growth and further chronic inflammation. In this way a colitis may be established throughout the entire length of the large bowel.

A SIMPLE METHOD OF SUTURING ALL HOLLOW VISCERA.

BY WILLARD BARTLETT, M.D.,

OF ST. LOUIS, MO.

A GRADUAL process of simplification during years of intestinal and stomach work finally brought me to the routine use of a method which study of the literature shows to represent in a measure the apex of a pyramid to which others have contributed the underlying strata. In reviewing the propositions which are of importance here, it is not logical, in view of what follows, that I take up the immense number of suggestions which have been made for uniting hollow viscera by methods other than those which deal with a single row of sutures embracing all coats.

The history of the continuous suture in gut work runs back much farther than many perhaps imagine. As early as 1724 Heister¹ wrote regarding it as follows:

Wenn aber die Wunde im Darm gross ist, so ist dieselbe meistens todlich. Denoch weil man auch solche Patienten ohne Hülfe nicht lassen soll, so muss man dergleichen verwundte Darm ohne die Nath nicht in den Leib bringen, sondern dieselbe vorher zunahen: welches bishere durch die, so gennante Kurschners' Nath verrichtet worden, welche (Tab. viii, Fig. 10) angemahlet, repräsentiret wird. Zu dieser werden erfordert eine gemeine gerade dunne Nadelgleichen gewachster seidender oder leinener Faden.

It is not stated definitely by him whether or not he advocated perforating sutures; however, the well-known glovers' stitch of which he writes surely takes in the entire thickness of the leather, hence it is probable that Heister advocated a continuous suture which penetrated all the coats of the bowel. He quotes the work of earlier authors, which goes to show that this sort of manœuvre was known long before his time. Of course none of these very early authors appreciated the fact that serous coats must be approximated, hence their work can be

regarded as of historic interest only. Still it must be admitted that such accidental approximation was probably secured in many instances because some of their patients recovered.

In 1826 Jobert ² used a perforating interrupted suture.

In the same year, according to Jeannel,³ Breidenbach used a suture which was apparently somewhat similar to that of Jobert, although there seems to exist a degree of uncertainty as to just where this method was published and whether or not interrupted stitches were of the variety which embraced all the coats of the bowel.

Gely ⁴ was the next, in 1842, to use in a long series of animal experiments a perforating suture, which, however, was of the continuous variety.

Three years later Moreau ⁵ advocated an interrupted perforating method in which a cuff of the mucosa was stripped out of one end of bowel into which the other was invaginated.

Vezién,⁶ in 1871, wrote of using interrupted perforating stitches very similar to those of Jobert.⁷

In 1882 Nussbaum ⁸ advised that all intestinal sutures embracing all the coats of the bowel be of the interrupted variety and have the knot on the inside.

In 1885 Bishop ⁹ used perforating gut stitches. M. E. Connell,¹⁰ in 1892, renewed the interest of the surgical world in this form of suture by publishing an oblique one-row method with a continuous suture embracing all the coats. In the same year Maunsell ¹¹ published his unique proposition of slitting the bowel laterally, drawing the ends to be united through this slit, and sewing them together with a single interrupted row embracing all the coats. The next step was registered by Cushing,¹² in 1899, when he proposed a continuous single row which was not intended to embrace anything below the submucosa.

Popular recognition of the single row suture embracing all the coats was not, however, apparent until 1903 when F. G. Connell ¹³ gave to the world his method of interrupted suture. In the same year Horsley ¹⁴ published what he called a single row over-hand continuous suture embracing all the coats. Wiggin ¹⁵ demonstrated a single row interrupted suture

with all knots inside. In 1905 Horsley¹⁶ again wrote concerning viscera of unequal size.

The method herein advocated consists of a single row of continuous silk sutures taking in all of the viscera. No internal support is used. No special forceps or other instruments are necessary; all that is required is simple straight cambric needles and silk or other thread, as may be desired. I prefer silk, on account of its well-known physical properties, to any other suture material and use it in this way: two very fine strands of double length are carried through the eye of a Number 7 needle, then the resulting four are twisted together so that the needle remains at the end of a completed cable from which it cannot become detached. This is waxed, sterilized, and a large number held in readiness for immediate use. Four strands are used because two are not enough to make a smooth cable.

The experience of many operators has proven the single row suture anastomosis to be perfectly safe. Two or even three rows can then not guarantee more, since the rules of logic preclude the use of a comparative or superlative term that can amplify "perfectly safe." I will add that in careless or inexperienced hands more than one row might add somewhat to the safety of the operation, but this proposal is not for the beginner.

In comparing continuous and interrupted suture, all must admit that the continuous can be applied more quickly. A second advantage possessed by it is that it alone tends to hold the opposed viscera more tightly together when the tension within the lumen increases, as is likely after post-operative gas formation takes place.

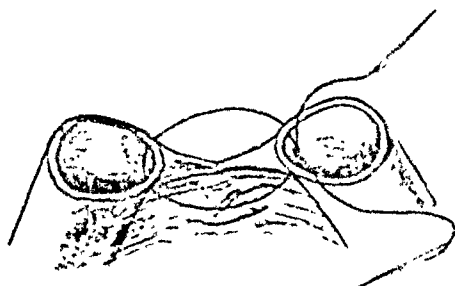
Now as to the value of perforating suture. In one sense a stitch which takes in all the coats is best because it is sure to embrace the submucosa, which is the only one that offers a sure foundation. F. G. Connell proved long ago that it is practically impossible to catch submucosa many times without some of the needle holes entering the lumen of the bowel. This was done in a most ingenious manner by comparing the

thickness of this layer with the diameter of the needle ordinarily used. Since it has been abundantly proven by this author as well as by others that perforating stitches are harmful in theory only, why not carry all gut needles into the lumen and thus be sure to get the firmest sort of a hold?

END-TO-END ANASTOMOSIS.

Two threads about fourteen inches in length with a needle on each are tied together at the free ends; thus we have resulting a strand slightly over two feet in length with a needle on both ends. By referring to Fig. 1, it will be noted that the first step in the operation begins within the lumen of the gut on the left, each needle being carried out of the viscus in

FIG. 1.



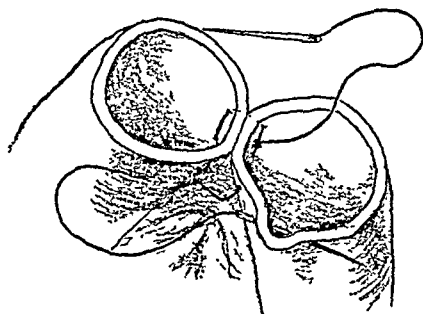
End-to-end anastomosis, first stage

such a manner as to embrace the mesenteric insertion, the same being done to the mesentery of the bowel to the right as the two needles enter the lumen. These two threads are now tied together after the knot has been drawn tight and the resulting condition appears in Fig. 2. This is a most important step, since, as shown by F. G. Connell and others, it guarantees in a measure the blood supply to the part on which we are working.

Fig. 2 illustrates the next step in the procedure. A few stitches of the continuous Connell variety are taken, all of the coats being pierced and a close approximation being secured as the thread is drawn tight. As illustrated by the needle next the reader, most of these sutures are put in by making the in-and-out excursions in one and the same direction

in very much the same way that a Lembert suture is applied, the sole difference being that here all of the coats are embraced. This needle is employed for a distance of about one-third the way around the opening, when it is dropped and exactly the same manœuvre repeated in the opposite direction with the needle farthest from the reader, the single difference being that this latter needle is employed for the remaining two-thirds of the circumference or until it meets the one first used, when it will be found that the opening has been completely closed so quickly and simply as to astonish the operator. Almost all of the stitches will have been put in from the outside, and nowhere will anything but the peritoneal coat show. If the

FIG. 2.



End-to-end anastomosis, second stage.

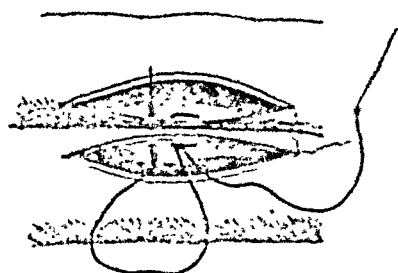
tension of the thread has been right it will be impossible to see any portion of it except the knot, which, contrary to theory, has done no harm if left exposed, although I must say that I have usually placed one Lembert suture over it for cosmetic reasons. Beginning the anastomosis at the mesentery and working away from it in both directions as described above, renders the manipulation of this important and dangerous territory much safer and easier than is the case when an ordinary continued suture which has gone clear around the gut is finished at the mesenteric insertion.

LATERAL ANASTOMOSIS.

Fig. 3 shows two loops of intestine placed side by side, with the first suture tied within one lumen, leaving the two needles ready for use. The one on the left is employed to

make an ordinary running Connell suture to the left of the first knot. This is continued only until the corner is turned, when this needle is dropped and the same manœuvre carried out with its mate to the right of the first knot. The advantage of beginning in the middle to make this suture is that both the difficult corners can be turned with the whole wound wide open, which is not the case if the operator begins at either end. Now that the posterior row has been completed and drawn tight, the operator has nothing left to do but continue the anterior row, inserting the stitches in the manner shown by the needle next the operator in Fig. 2. Each thread makes half of this anterior row, the two meeting at the middle of the wound, where they are tied as shown in Fig. 4, and a simple

FIG. 3.



Lateral anastomosis, first stage.

anastomosis thus concluded. Again a Lembert suture may be superimposed if desired, although I must state that I have frequently forgotten it and the results have been just the same as where it was used.

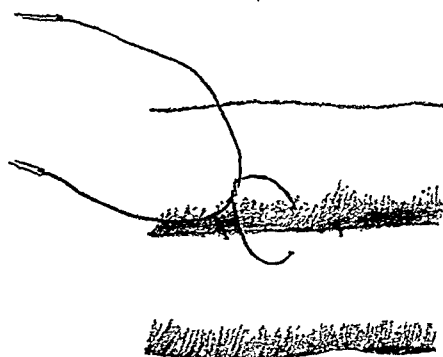
END-TO-SIDE ANASTOMOSIS.

This somewhat less common form of operation is depicted in Fig. 5, where a Roux gastro-enterostomy is in contemplation. Again we have emphasized the importance of the first silk loop which approximates the middle of the stomach wound with that portion of the small intestine which embraces the mesenteric insertion. It is scarcely necessary to dwell upon the further steps of the operation, since they are merely a combination of those given in end-to-end and lateral anas-

tomoses. The posterior row approximates the two viscera, being inserted after the continuous Connell method, while the anterior row is again made after the manner of using the needle next the reader in Fig. 2. The resulting ends of thread are tied as in Fig. 4, and the operation is complete.

This form of suture has been found equally well applicable wherever tried and, as the following list will show, its use has met the widest possible indications in end-to-end, lateral, and end-to-side anastomoses. The stomach has been connected with the small bowel anteriorly as well as posteriorly by the lateral method as well as end-to-side in the Roux operation. Small bowel has been connected with small bowel by both the lateral and end-to-end methods. The small bowel has been

FIG. 4.



Lateral anastomosis, second stage.

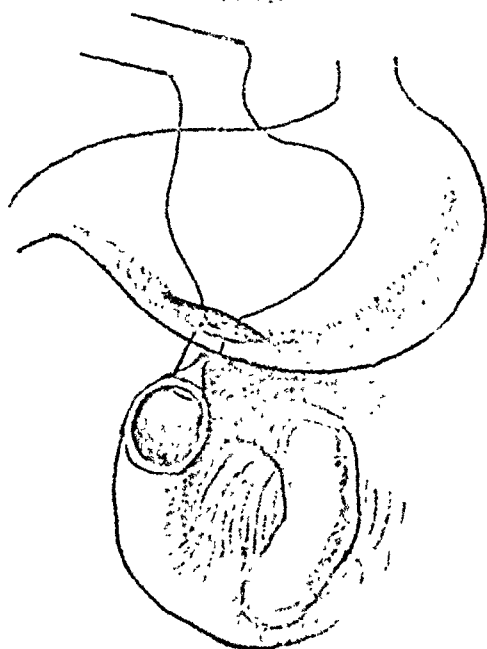
united with the large bowel, not only laterally but end-to-end. The gall-bladder has been anastomosed into the stomach in one instance and in another into the large bowel. Not only has this method been used in seemingly normal viscera but on those changed by disease in almost every conceivable manner. It has proven its value in a distended gut above an acute obstruction, also in the œdematous condition associated with acute peritonitis. It has been equally successful in the compensatory thickening associated with chronic obstruction.

After resection of the head of the ascending colon, there has been practically no difficulty in making end-to-end anastomosis between the ileum and colon of vastly different diameters. To illustrate the ease and speed with which the method

can be applied, it is enough to state that a double resection with double anastomosis has been accomplished in about the same time that the single operation of this sort formerly took where complicated methods of bowel union were used. The Roux gastro-enterostomy has been frequently used in my work recently, since this simplified suture has made it possible to perform the operation in about the same time that was formerly required for a posterior gastro-enterostomy alone.

I have used this method for more than two years in every

FIG. 5.



Roux-Y gastro-enterostomy.

operation which I have done upon the hollow viscera of the abdomen, a very large number of cases in all.

That it is a thoroughly useful procedure, to say the least, is attested by the fact that only two of all of these patients died in the hospital of any cause, neither of them with peritoneal symptoms; one expired sixteen days after a gastrectomy and the other two days after an anastomosis between gall-bladder and stomach for the relief of biliary obstruction in cancer of the pancreas.

This method is safe, because all of the coats of a viscus are embraced and consequently every stitch has a *firm foundation*.

No form of suture operation could be done more quickly, because the smallest possible number of stitches and knots are employed.

No permanent ill after effects are to be anticipated, since a very scanty diaphragm is formed.

The requirements of modern surgical technic are not satisfied by any method of anastomosing hollow viscera which does not guarantee safety, rapidity, and absence of bad after-effects.

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THE RECTOSIGMOIDAL ARTERIAL ANASTOMOSIS.

ITS IMPORTANCE IN THE TREATMENT OF CARCINOMA HIGH IN THE RECTUM.

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It has occasionally been noted that operations by the sacral route upon carcinomas situated high in the rectum have been followed by gangrene of the bowel which has been freed to permit of the establishment of a perineal or a sacral anus. On reading the mortality rate in this field of surgery and having observed some of the unfortunate results, one is struck by the repeated report of partial or complete gangrene of the bowel in the fatal cases. It was with this point in view that this work was undertaken, with the hope that some definite idea could be obtained of a method to avoid this complication.

Quenu and Hartman were the first to open the abdomen to ligate directly the superior hemorrhoidal artery to check hemorrhage and to permit of an easier mobilization of the rectum. Hartman more recently has shown that the safe point for ligation of its superior hemorrhoidal artery is proximal to its junction with the anastomotic loop from the sigmoidal artery (Figure 1, *A*). After ligation at this point the blood passes from the sigmoidal artery through the anastomotic loop and into the rectal vascular system below the level of the ligature. Ligation of the superior hemorrhoidal artery distal to the anastomotic loop would result in gangrene of the stump, as the main vessel distal to the loop would be occluded, and the blood supply to the rectal wall cut off.

It has been demonstrated experimentally by Rubesch that the area supplied by the inferior mesenteric artery can be in-

The author wishes to express his appreciation of the kindness of Drs. Bensley and Harvey for their assistance and for the use of their dissecting room material.

jected through the superior mesenteric artery after ligation of the former. This observation can only be regarded as an interesting anatomical fact, for clinically a collateral circulation is not provided rapidly enough after ligation of the inferior mesenteric artery to prevent gangrene, even if the branches of the artery are not to be regarded as terminal arteries. Sudeck was the first to emphasize the necessity of an abdominal incision to determine the exact location of this anastomosis, which he names the "critical point."

Variations in the rectosigmoidal anastomosis are common. With the view of determining the frequency and nature of these variations, and the relation of the vessels entering the anastomosis to the bowel wall and to each other, I have examined 21 subjects. The vessels had been injected with a starch mass containing lead oxide. In some cases the vessels were dissected out to the bowel wall, while in others the relationship of the vascular loop was determined by X-ray pictures. Reproductions of some of these accompany the text.

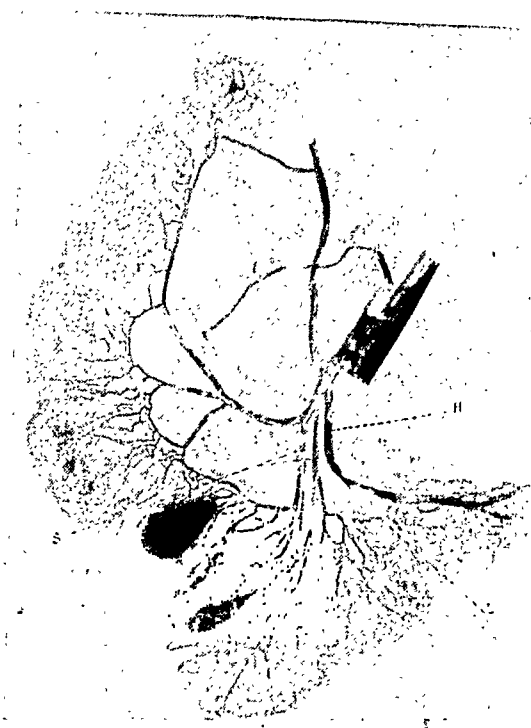
Three of the subjects were females. These showed no variations which can be considered peculiar to the sex. A definite, well-developed loop was absent in two cases (Fig. 2). In these instances ligation of the superior hemorrhoidal artery at any point would have resulted in gangrene, as the vascular anastomosis within the wall of the bowel would not furnish enough blood. After resection of the rectum for a high lying carcinoma in such cases, it would be safest to draw the proximal end of the rectum or sigmoid out through the abdominal wall and form an iliac anus. The loop varied in calibre from an artery as large as the vessels it connected to a mere thread-like vessel in one instance. The loop was found on an average 1.5 cm. below the level of the promontory of the sacrum (Fig. 1). In one subject, however, the loop was found 5 cm. below the promontory. The anastomosis was found at a varying distance from the bowel. The rule of clamping the vessels as far back from the rectum as possible, to avoid injury to the blood supply when operating by the sacral route, results in missing the loop where it lies close to the bowel, as in Figs.

FIG 1



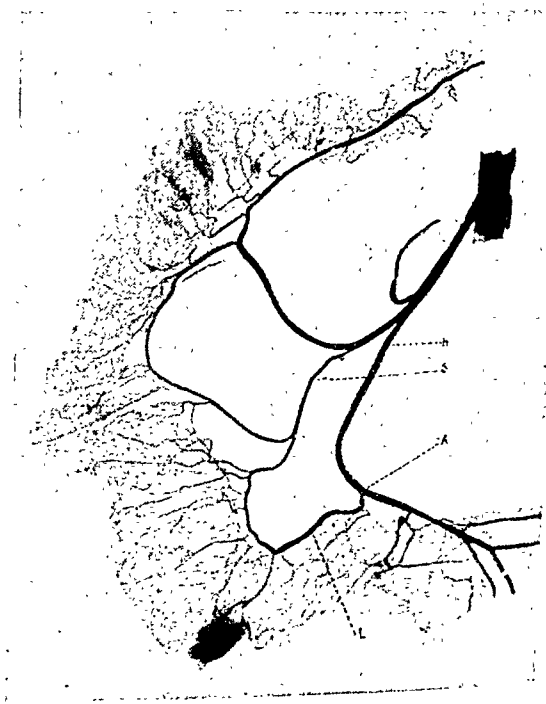
Figure 1. A close-up photograph of a mineral specimen showing a complex, granular texture with numerous small, dark, irregular spots and streaks. A prominent, dark, linear feature runs diagonally across the upper right portion of the image.

FIG. 2.



S, sigmoidal arteries; *H*, sup. hem. artery; *L*, no well-developed loop present.

FIG. 3.



A, critical point; *S*, sigmoidal artery; *H*, sup. hem. artery; *L*, loop lies close to bowel.

Fig. 2



A. external p. nt., S. external p. nt., H. external p. nt.,
 L. external p. nt., L. external p. nt.

Fig. 3



FIG. 6.



A, critical point; S, sigmoidal vessels; H, sup. hem. arteries, bifurcation proximal to anastomosis; L, loops double, distant from bowel.

FIG. 7.



A, critical point; S, sigmoidal artery; H, sup. hem. artery; L, loop.

Fig. 4



A, critical point; S, supplied artery; H, hysteresis; L, double loop

Fig. 5



3, 4, and 5. With relations as shown in Fig. 6, on the other hand, there would be great danger of catching some portion of the loop, because it arises so far from the bowel. After occlusion of the vessels, gangrene of the stump occurs in greater or less extent, the faeces escape into the wound, and if infection reaches the peritoneal cavity the patient dies of peritonitis.

In several instances the bifurcation of the superior hemorrhoidal artery occurred before the sigmoidal loop joined the rectal supply (Figs. 1 and 5). In most of these cases the sigmoidal branch joined with the upper division of the hemorrhoidal artery; in two cases, however, it anastomosed with the lower division. In these instances ligation immediately above the junction of the sigmoidal loop (Fig. 1, *B*) would be dangerous, and ligation should be performed above the point of division of the superior hemorrhoidal artery at *A* in Fig. 1. This division of the superior hemorrhoidal artery is variable as shown in Figs. 4 and 5, the length of the main artery varying from 2 cm. in Figs. 1 and 5 to 6 cm. in Fig. 7. In some instances this artery passes down as a single trunk from the inferior mesenteric artery to its subdivision upon the rectum (Figs. 4, 8, and 9).

Section of the superior hemorrhoidal artery above would permit of mobilization of a considerable length of the sigmoid (Figs. 1, 3, and 9). With a condition as shown in Fig. 7, section of the hemorrhoidal artery and the small division of the sigmoidal artery would give ample movement to the sigmoid colon; but with a vascular system as pictured in Figs. 2, 4, 6, 7, and 8, several large trunks would have to be sacrificed to obtain any marked descent of the sigmoid.

CONCLUSIONS.

Total twenty-one subjects: loop present in 19 cases; superior hemorrhoidal artery bifurcated before junction with loop, 7 cases; loop anastomosed with lower division, 2 cases.

Lowest loop was found in one subject with the critical point almost in bottom of cul-de-sac of Douglas. Vast majority of other cases were found about 1.5 cm. beneath the promontory of the sacrum.

Sixteen subjects showed the loop close to the bowel.

Five subjects showed the anastomosis formed by large loops at a distance from the bowel.

1. Following high resection of the rectum, gangrene of the stump can be avoided by ligation of the superior hemorrhoidal artery proximal to the point of entrance of the anastomotic loop from the sigmoidal artery.

2. Where high resection of the rectum is to be done by the sacral route, a preliminary abdominal incision is of value to determine the presence and location of the critical point, the relations of the superior hemorrhoidal artery, and permits of a definite placing of ligatures to check hemorrhage.

3. The anastomotic loop is not present in some cases. High resection of the rectum for carcinoma in these cases should be terminated with a permanent colostomy.

The X-ray pictures are printed as viewed from behind.

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THE BONE METASTASES OF HYPERNEPHROMA.

A COMPLETED RECORD OF A CASE WITH SOLITARY BONE METASTASIS.

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Harvard Medical School.

IN the ANNALS OF SURGERY for December, 1906, p. 851, I published the report of certain cases of hypernephroma occurring at the Massachusetts General Hospital clinic. One of these cases was reported in considerable detail. I wish here to complete the report of this case, numbered XI in the former paper.

The facts of interest in connection with this particular case are as follows: It was thought previous to operation that this man had a sarcoma of the upper end of the shaft of the right humerus (Fig. 1). An amputation at the shoulder-joint was done (Fig. 2). The microscopic examination of the removed tumor demonstrated that it was a hypernephroma (Figs. 3 and 4). Before the patient recovered from the anæsthetic, careful palpation of both kidneys discovered a slight enlargement of the left kidney. He had had no pain in the side and no hæmaturia. During the casual inspection in the routine ward examination this slight enlargement of the left kidney was not detected previous to operation.

Certain questions of practical importance arose at that time, namely: What is the proper attitude toward the kidney tumor as yet manifesting no symptoms? Shall it be removed? If removed what will be the prognosis? In this particular case the diagnosis of hypernephroma was made first from an examination of a metastasis. The metastasis first suggested the presence of a hypernephroma. The very great proneness of the hypernephromata to metastasize as demonstrated by autopsy reports and the fact that the metastases are usually multiple would lead one to give an unfavorable prognosis in this particular case.

even after nephrectomy, were it not for a series of very careful observations by Albrecht¹ from Hochenegg's clinic in Vienna, to the effect that there may exist a solitary hypernephroma metastasis in bone. In this Case XI of my series, it was thought possible that this bone metastasis, which had been removed by amputation, might be the only metastasis in the body.

The feeling with regard to this case at the time of the operation was that a chance for the man's life lay in a nephrectomy, but that this would be efficacious only if there were no other metastases in the body. Nephrectomy was urged upon this man but he constantly refused operation.

In January, 1910, a little less than five years after operation, he died, wasting away as if with some blood disease. It was possible to make a complete autopsy with the exception of an examination of the spinal cord. The cranial cavity, thorax, and abdomen were thoroughly examined. There had been no return of the trouble locally at the seat of the original operation. The left kidney was as large as two adult fists. The accompanying photograph (Fig. 5) shows the relation of the tumor to the kidney itself. The pathological report upon the tumor made by Dr. Oscar Richardson is appended. No metastases were found in any part of the body. The man had had no symptoms, so far as is known, from the kidney tumor.

This case, then, first reported in the *ANNALS OF SURGERY* for 1906, is now rendered complete by autopsy. This case adds one more bit of evidence to the two cases from Hochenegg's clinic illustrating the fact that one bone metastasis may be the sole metastasis present in the body. Had a nephrectomy been done soon after the operation for removal of the upper extremity containing the metastatic focus, the man's life would have been prolonged.

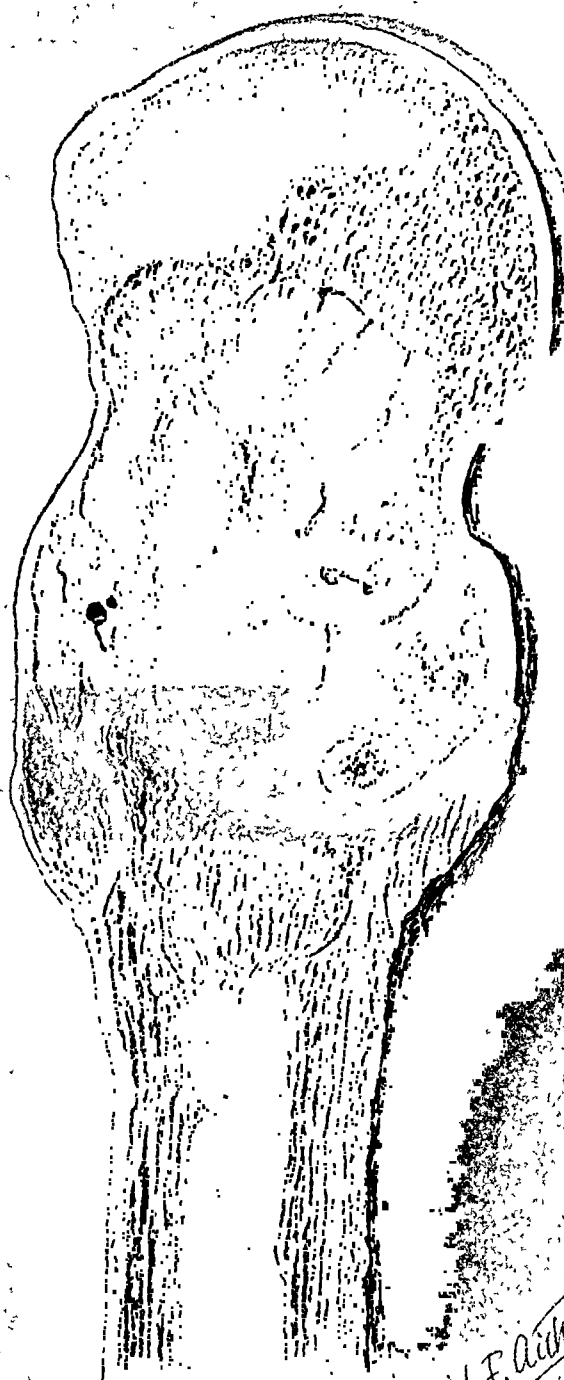
Report of microscopical examination of hardened and stained sections from a tumor of the kidney, Case XI, Series Massachusetts General Hospital Hypernephromata, April 7, 1910:

The sections all show a distinct meshwork of capillaries between and along which rest irregular columns and small masses of rather large epithelial-like cells with a rather well-marked eosin staining granular protoplasm in places, but showing elsewhere rather generally a thin vacuolated, faintly staining protoplasm. The nuclei are rather large.

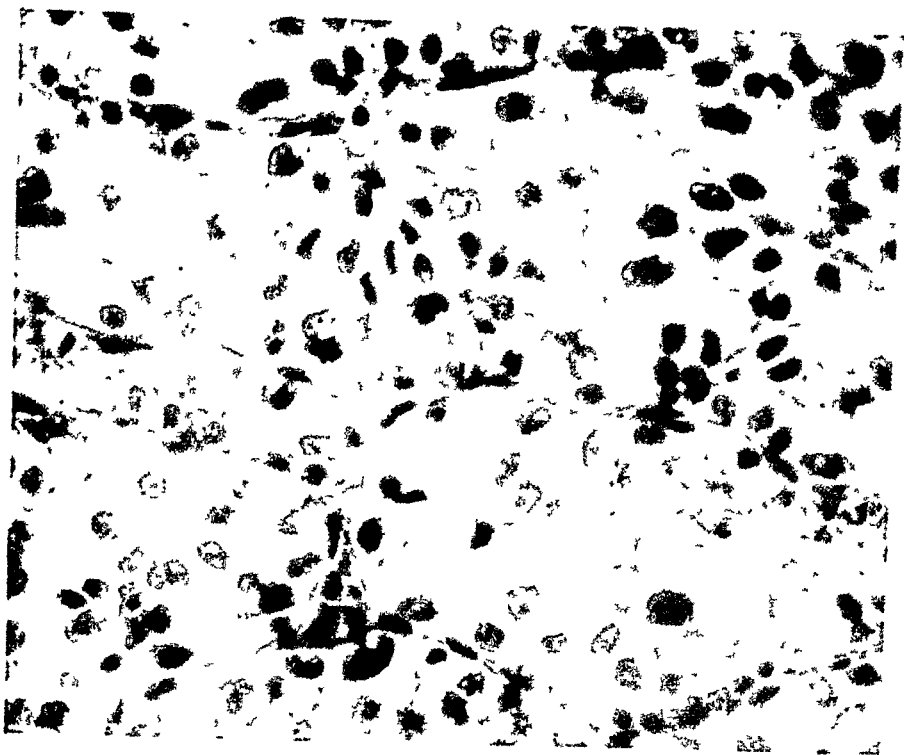
¹ Arch. f. klin. Chir., 1905, lxxvii, 1073.



FIG. 2.



Hypernephroma, metastatic, in upper end of the shaft of the right humerus. Drawing made from a section of the gross specimen.



Microplate, high magnification, showing a dense field of cells. Oval poly, small cell, some of the cells are highly refractile. Microplate, high magnification, showing a dense field of cells.



Microplate, high magnification, showing a dense field of cells. Oval poly, small cell, some of the cells are highly refractile. Microplate, high magnification, showing a dense field of cells.

FIG. 5



Hypernephroma of kidney of Case XI removed at autopsy. The kidney and tumor have been split. Each half of the section is shown in the photograph. The photograph was by Mr. Brown of the Pathological Laboratory of the Massachusetts General Hospital. See pathological report.

well defined, and show well-marked chromatin granules. In instances nucleolus-like masses are seen. The protoplasm of the cells which are arranged along the walls of the capillaries rests in close association with the wall of the capillaries. This arrangement of cells and capillaries resembles quite a little the structure of the cortex of the adrenal gland. In many places there are coarse trabeculae of connective tissue from which finer prolongations extend in among the capillary network. Here and there in the midst of the connective tissue there are collections of small round cells. The peripheral cells of some of the small masses of tumor cells are arranged around and along the walls of the capillaries in such a fashion that roughly they present a tubular formation. In many places the tumor sections show well-marked areas of necrosis. At other points the capillary walls surround large oval spaces with comparatively few atrophic degenerated looking cells resting along the walls of the capillary meshwork.

Diagnosis: Hypernephroma.

(Signed) O. RICHARDSON, *Assistant Pathologist, Mass. General Hospital*

PLASTIC REPAIR OF THE THUMB.

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OF NEW YORK,

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THE case embodied in this report possesses interest because of the fact that the patient came under the observation of the writer after the decision to amputate the afflicted thumb had been reached, and because the measures employed eventually made preservation of a useful member possible. It is also regarded as worthy of record on the ground that the thumb is, as is well known, "half a hand," and its removal entails considerable loss of function and consequent lessening of the earning capacity of one concerned in doing manual labor for a livelihood.

Miss X., aged fifteen, came under observation December 4, 1909. The history obtained at that time was that three months previously she had broken off a cambric needle in the left thumb near the interphalangeal joint. This was removed under local anæsthesia. Several days later the thumb became painful and swollen, and evidently was quite acutely infected. This was treated with a wet carbolic acid dressing which resulted in a carbolic acid gangrene.

The consequent sloughs separated very slowly, and at the end of three months the thumb appeared as shown in Fig. 1. The distal phalanx is contracted, the interphalangeal joint is ankylosed, and the area of granulation shown had not undergone any change in size for several weeks. It was believed that the infection had invaded the joint and exfoliation of bone had taken place. A radiograph (Fig. 2) showed this to be true. It will be seen that the joint surfaces are quite effaced and that some of the phalanges themselves have separated. The extent of bone disease is best recognized by comparing the radiograph

of the afflicted thumb with that of the other normal thumb contiguous to it.

It was deemed proper to make an effort to save the thumb, and it was believed that an ankylosed interphalangeal joint was less objectionable than would obtain were an amputation at the metacarpal phalangeal articulation performed. The indication seemed to be to excise the granulating area of soft tissues, remove what dead bone was still existing, and make plastic repair of the denuded area.

Accordingly, on December 6, 1909, the technic was carried out in the following way: The entire granulating surface, together with the contiguous scar tissue, was excised. Only a very small sequestrum was found, and this was removed with the Volkmann spoon. The joint cavity itself was filled with new bone which was only slightly disturbed in removing the sequestrum. A bridge flap was now fashioned at the anterolateral aspect of the thigh. Its conformation and application to the denuded area on the thumb are quite well shown in Fig. 3. This site was selected for the purpose after considerable experimentation with the thumbs of the writer and his assistants. The reader is asked to place his own thumb in position to allow of its dorsal aspect being placed in the relationship shown in the picture (Fig. 3) on a portion of the body without twisting the wrist-joint and thus making tension on the flap. It will be found that the one selected in the case reported is perhaps the only one available for the purpose, except perhaps the pectoral region on the side of the body opposite to the thumb used. The latter site would not be objectionable in the male, however in females it is fair to assume that this region is regarded as offering certain allure to the opposite sex which the scarring following an operation of this sort would be likely to destroy.

The bridge flap consisted of skin only. The subcutaneous fat was left attached to the fascia lata, making a bed for the palmar surface of the thumb to rest upon.

The edge of the flap toward the wrist was with three interrupted silkworm gut sutures, small Hagedorn needle. The distal edge of the flap was closed by a single silkworm gut suture. The latter suture, of course, as no doubt the introduction of foreign material would have traumatized unwarrantably the distal portion of the part.

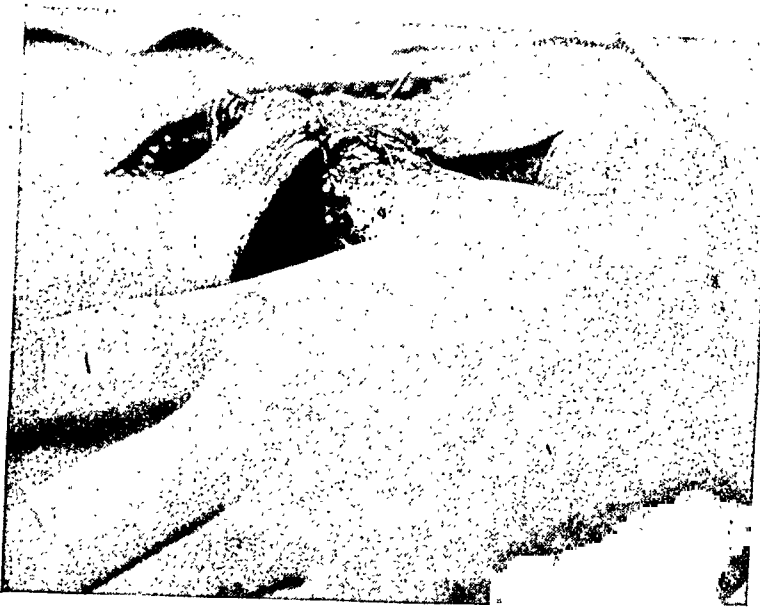
December 10 (four days after the operation), one-half of the lower portion of the flap was sectioned with scissors. The edge of the wound on the thumb side bled quite freely, showing that the circulation was maintained at this time.

At this time the edge of the wound in contact with the thumb showed a slight reactionary inflammation. There was no evidence of infection, however, and the patient's general condition was very satisfactory. The entire arm, hand, and thigh had been immobilized at the time of the operation, using adhesive plaster straps for the purpose. Of course considerable annoyance was caused the patient by the strained position she occupied, and especially was it difficult to take care of the urine and feces without disturbing the parts concerned in the repair. The latter consideration would not be so important a factor had it been feasible to use a portion of the trunk for the purpose, as then immobilization of the parts would have been much simplified. Due consideration should be shown this aspect of the situation in cases where plastic repair is attempted; however in this case it would seem that the method employed was justified.

December 12 (six days after the primary operation and two days after partial section of the lower portion of the flap), the upper portion was sectioned to the extent of one-half its breadth. The second section was made at the side of the bridge flap opposite to the one made two days before, in the lower portion of the flap. This was done in this manner to conserve circulation from the widest possible contiguous areas. At this time there was some odor emanating from the wound; however this was found to be due to secretion and not, as was at first feared, to sloughing. When the upper section was made, bleeding occurred from both the thumb and the thigh sides of the incision, showing that circulation was quite maintained in the flap. The distal end of the thumb was quite buried in granulating tissue, which had grown up from the thigh wound as will be seen in Fig. 4. There was but a meagre portion of the thumb protruding from that side of the flap at the operation (Fig. 3), and its burial in granulation tissue is not to be wondered at. Fig. 4 shows the condition of affairs at this dressing. The lower wound where the flap was first partially sectioned had begun to granulate at this time. The upper section shows more plainly, being freshly made a few minutes before the



FIG. 3.



Bridge flap on anterolateral aspect of thigh. Thumb fastened to flap with silkworm gut sutures.

FIG. 4.



One-half of either margin of bridge flap sectioned. The section to the left already beginning to granulate. Upper (right) section freshly made. Distal end of thumb buried in granulation tissue.



FIG. 6.



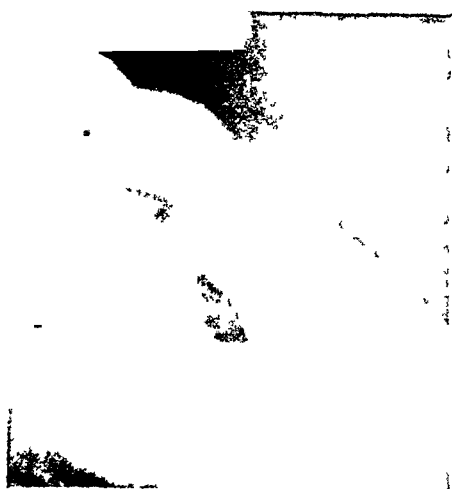
Lateral view of thumb nine days after release from thigh. Note contraction and adaptation of graft.

FIG. 7.



Lateral view of thumb two months after operation showing farther contraction of graft.

FIG. 8



Same as Fig. 7 (two months after operation)
Dors. View

FIG. 10



Same as Fig. 9 (two months after operation)

photograph was taken. One of the sutures at the wrist side of the flap was removed at this time. On the whole the conditions were favorable, yet there was an abundant amount of secretion which, as already stated, had some odor. Ordinarily the presence of odor may be regarded as of unfavorable prognostic import in plastic cases, though in this case it proved not to be so.

December 14 (eight days after the operation), the flap was entirely sectioned and the thumb released from the thigh. Fig. 5 shows the condition at this time. The flap is seen to extend to a considerable degree beyond the edges of the thumb itself. However the space beneath it is filled with granulation tissue, and if healing progressed we had a right to expect much contraction at both edges of the flap. The edges of the flap bled freely. Indeed a streak of blood is seen in the illustration (Fig. 5) flowing from the thumb across the dorsal side of the hand. This argued well for a successful outcome.

The thigh wound was dressed in the usual way, but the thumb was enveloped in a wet saline dressing. The presence of odor would suggest the employment of antiseptics; however we felt that the nutrition of the parts was best conserved by the use of the sterile saline solution.

December 23 (17 days after the operation and nine days after release of the thumb from the thigh), the conditions present were those shown in Fig. 6. This is a lateral view of the thumb. In front little of the nail is seen. At the sides repair is slowly going on. At each dressing following release of the thumb from the thigh, a small slough formed at the edges of the flap which was each time cut away. This slough formation was no doubt due to the fact that a small area of flap did not receive sufficient nutrition to maintain it.

At this time the thumb did not present a very symmetrical appearance. The thumb is shown in this rather unfavorable condition to act as a guide in similar cases, where unnecessary disappointment might be felt by the patient at its appearance, since, as is shown later on, marked improvement occurs in the end.

February 6, 1910 (two months after the operation), the thumb appeared as shown in Fig. 7. Comparing this to Fig. 6, it will be seen that a marked contraction of the grafted tissue has

WRIGHT'S SOLUTION OF SODIUM CITRATE AND SODIUM CHLORIDE FOR DRAINAGE.*

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ONE of the most rational and efficient therapeutic measures that has been offered in the treatment of localized infection is the solution of sodium citrate and sodium chloride devised by Sir Almroth E. Wright. This solution is composed of sodium chloride 4 per cent. and sodium citrate 1 per cent. in water.

THEORY.

Surgeons for years now have railed against wicks, wicks which do not drain. A wick in a few hours becomes clogged with the coagulation of blood, lymph, and pus, and becomes more of a plug than a drain. Removal of such a wick twelve to twenty-four hours after its insertion is frequently followed by a gush of retained pus. Coagulation and crust formation are the foes of good drainage and have led to the expressions, "Let your drainage be efficient," "Make a surgical incision," and "Whatever you do, do not make a *medical* incision." Nature's way of draining an abscess through a small hole is for all reasons the best if the free flow of pus can be maintained.

The essential factor to limit or to begin the "cure" of an abscess is free bathing of the bacteria in the walls of the cavity with fresh serum from the blood, with its high antitoxic power. If such a free bathing of serum can be made continuous without introducing hemorrhage or causing injury to the tissue, here indeed would be for the first time a rational method of dealing with localized infection.

Wright's salt and citrate solution seems to fulfil these requirements. Sodium citrate (1 per cent.) in the solution

taken place, and this as the outcome of natural adaptation and not due to any treatment. The thumb is, however, not to be regarded as one likely to inspire sculptors to ecstasy.

Fig. 8 shows the thumb from its dorsal aspect, the photograph being taken at the same time as that shown in Fig. 7. This illustration (Fig. 8) shows some fine hair growing on the flap, which is also objectionable from a cosmetic stand-point.

February 23, 1910 (ten weeks after the original operation), the dome of the flap was excised by removing an elliptical portion as shown in Fig. 9. The parts bled freely, showing that new blood-vessels had developed in the grafted tissues. The thickened portion was composed of dense connective tissue which was excised to some extent beyond the edges of the superficial incision, with the view of thinning out the graft. Five horsehair interrupted sutures were introduced and when tied the part appeared as shown in Fig. 10.

Fig. 11 shows the condition of the thumb on May 10, 1910 (about five months after the original operation and about three months after the last operation). The ultimate result is an ankylosed interphalangeal joint, a not particularly offensive looking thumb and one which is useful in the performance of most necessary manipulations of ordinary life.

The report of the case is gone into thus in detail with the view of aiding the reader in formulating a method of repair in similar cases. Last but not least, attention is called to the fact that the original affliction was no doubt greatly contributed to by the use of carbolic acid used over a considerable period of time, a measure of doubtful utility at best and always liable to result in some such condition as obtained in this instance.

WRIGHT'S SOLUTION OF SODIUM CITRATE AND SODIUM CHLORIDE FOR DRAINAGE.*

BY L. R. G. CRANDON, M.D.,

OF BOSTON, MASS.,

Assistant Visiting Surgeon, Boston City Hospital; Assistant in Surgery, Harvard Medical School; Consulting Surgeon, Frost General Hospital.

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causes a precipitation of calcium salts in the lymph, removing thereby that which is essential to coagulation. The presence, then, of the sodium citrate in the wound cavity ensures a comparatively free exit of the lymph discharge. The sodium chloride, in hypertonic solution (4 per cent.), by osmosis brings about a flow of lymph through the walls of the cavity, the sodium citrate having dissolved clot and prevented further coagulation. Thus there is brought about a continuous pouring forth of lymph of high antitrophic power from the blood stream and lymph spaces, through the walls of the abscess cavity and out through the wound. The 4 per cent. solution is in itself antiseptic since bacteria will not grow in it.

PRACTICE.

To Sanborn of Boston is due the introduction of Wright's solution into our practice.

Conclusive evidence that the salt and citrate solution as a dressing and irrigation contributes to the destruction of bacteria in the walls of the abscess cavity has been, and may be at any time, obtained in the laboratory.

A patient came to the clinic for treatment of an infected wound of the thumb, the result of operation for a streptococcus infection on the previous day. When first seen, in the wound was a thick coagulated mass of pus and lymph, which obstructed all flow. The patient had a temperature and the local condition showed swelling, tenderness, and was the cause of much pain. In order to test as to whether the phagocytic activity beneath this crust was at all efficient, the crust was removed and smears were made from the fluid expressed at the base of the wound. It was found that most of the phagocytes were disintegrated, but that some appeared to be normal. It was only in the rarest instances that the streptococci were to be demonstrated within a leucocyte, but, on the contrary, there was a profusion of streptococci growing in long chains outside the phagocytes. The patient was given a small inoculation of vaccine, and a dressing of sodium citrate and sodium chloride was applied to the wound. The patient was told to soak the thumb one hour out of four until the next day, and

between times to apply hot poultices of the same solution to the lesion.

On the following day, macroscopically, there was an entirely different picture. The thumb was less red; there was free discharge and an absence of crust. The temperature was normal. A smear from the lymph, expressed in the same manner from the depths of the cavity, showed a striking difference from that seen on the previous day. No broken-down leucocytes were to be seen. In practically all the leucocytes were found many inclusions of streptococci in pairs and in short chains, while outside the leucocytes there were no long chains to be seen and cocci were only occasionally found.

TECHNIC.

The abscess is opened by a wound as small as will allow the cavity to be wiped out, or thoroughly emptied by expression. The skin round the wound is thoroughly cleaned with 70 per cent. alcohol. The skin in this region, up to the very mouth of the wound, is smeared with boric acid or eucalyptus wash. If the skin tension closes the lips of the wound a bit of rubber dam may be put in. The wound is covered with a voluminous pad of gauze or of absorbent cotton covered with gauze, dripping wet with hot salt and citrate solution. A many-tailed bandage or some other application holds the poultice in position and the part is put at rest. Outside the dressing may be applied a hot flax-seed poultice or a hot-water bottle. In any case, as often as the dressing gets cold more of the hot solution is poured over the whole dressing to wet and warm it again, or the dressing is removed and the whole part is soaked, if possible, or bathed with the same solution.

PRECAUTIONS.

indicated where the formation of protective adhesions is desirable, as in certain abdominal wounds just after operation.

The solution should be used only for the first 36 to 72 hours after operation, during the acute stage of the inflammation. If longer used it leads to maceration and indolence in healing.

Two years of experience has amply proved the value of this solution. In office practice an abscess is opened, a small piece of rubber dam is inserted or not, a dressing with the inner layers wet with glycerin applied, and the patient is then given a recipe for one or more ounces of sodium citrate. He is told to go home, to add to a glass (eight ounces) of hot water about two and one-half teaspoonfuls of common salt and a large teaspoonful of the sodium citrate. With this solution he is to keep the dressing on his septic wound constantly wet and warm. Inguinal and axillary bubo, abscess of neck, septic fingers, mastoid wounds, otitis media after paracentesis, all drain most efficiently under this method. At the end of 36 to 72 hours the wound is filled with glycerin or balsam of Peru and is ready to heal.

THE RELATION OF THE DUCTLESS GLANDS TO SURGERY.*

BY J. E. SWEET, M.D.,

OF PHILADELPHIA,

Assistant Professor of Experimental Surgery in the University of Pennsylvania

THE relation of any given subject to surgery is primarily and always—in the broad sense—precisely the same as the relation of that subject to the fundamental field of the philosophy of medicine. There are certain things, however, which bear a more particular relationship to some one or other of the various special branches; among those fields in which surgery should be especially interested is the problem of the function and the pathology of the ductless glands.

The problem bears a threefold relation to surgery. In the first place, the surgeon is often specifically concerned with the treatment of the pathological conditions occurring in these glands. A mere enumeration of these structures will suggest many such instances, like acromegaly and exophthalmic goitre; this physiologic group comprises the hypophysis and perhaps the pineal in the brain; the thyroid, parathyroid, and carotid gland in the neck; the thymus in the chest; the spleen and the adrenals in the abdomen; the lymphatic system. There are also certain ganglion-like structures in various parts of the body, belonging to the sympathetic nervous system, and grouped together as the chromaffine system. In addition to the true ductless glands, many, if not all, organs with distinct ducts have also an internal secretion which may be even more important than the external secretion; the internal secretion of the liver is of far greater importance than its external secretion of bile.

requires a mastery of surgical technic to make possible an approach to the study of their function. An excellent example of this is the recent work of Cushing on the pituitary gland. Or, again, because of a surgeon's familiarity with the pathological picture, he may have acquired a peculiar position of authority in the study of the etiology of these conditions: an example of this is the work of Bircher on the etiology of goitre.¹

The last element in this threefold relation of these structures to surgery is the one to which I would especially call attention, a relation which, it seems possible, may exist in the practice of general surgery. I refer to the relation of that group of structures known as the "chromaffine" system to the blood-vascular apparatus, and specifically to blood-pressure. The term "chromaffine" is derived from the presence of certain cells which possess a peculiar affinity for the salts of chromic acid; in the case of the adrenals, it is considered satisfactorily demonstrated that these cells are the ones which contain the pressor substance characteristic of the gland. The chromaffinity of these cells is therefore taken as the index of the functional state of the gland, although a fair doubt of the correctness of this assumption may be entertained.

It is not within the scope of this paper to enter into a discussion of blood-pressure, because it is such a complicated problem that it cannot be handled at all unless exhaustively. For the purpose of the present argument, we will therefore leave out of consideration all the factors concerned in blood-pressure except three, which three, it so happens, are also the factors which must probably be most important in a given space of time, such as a surgical operation. These factors are: first, the vasomotor centres in the brain and cord; second, the paths along which the power generated in the centres is transmitted, the vasomotor nerves; and, third, the mechanism by which the power generated in the centres, and transmitted by the nerves, accomplishes work.

For our present purpose we may define blood-pressure as the result of an opposing of a resistance to the force of the

heart-beat; variations of pressure are brought about by varying this resistance. It is generally held by physiologists that the chief resistance to the blood flow is offered by the arterioles and not by the capillaries: changes in the calibre of the arterioles will greatly vary the resistance, and therefore the blood-pressure. These changes of calibre are made possible by the coat of smooth muscle-fibres which surrounds the arterioles. These muscle-cells are in a condition of semicontraction known as "tone," and they are kept in this state by factors entirely apart from the nerve-centres of the brain or cord.

If I may be pardoned a homely simile in order to make my point of view perfectly clear,—no matter how perfect the construction of the engine, no matter how correct the system for the transmission of power, the engine will probably saw no wood if there be no saw for it to turn; and if a saw be present the total efficiency will depend as much upon the condition of the saw as upon the perfection of the engine. To transfer these terms,—the vasomotor centres may be efficient, and the nerves may be normal, but the musculature of the arterioles may not be able to respond. No theory of shock can be complete unless all these factors are given their due consideration.

The result of the experimental removal of the adrenals as well as the study of cases of pathological destruction of the glands, in Addison's disease, shows that the internal secretion of the adrenals is directly concerned in maintaining the tone of the vascular system. It is for us immaterial whether the adrenalin act directly upon the muscle-fibre or upon the end-plates of the nerves within these fibres.

adrenals in addition to long periods of anæsthesia. We have not been in a position to systematically study all our experiments from the stand-point of the effect of ether narcosis upon the chromaffine system. Our observations have, however, led me to feel that the results obtained by others are, in the main, correct. I have also been able to prepare a few specimens and tracings for demonstration.

Wiesel² found in a number of cases of status lymphaticus an extraordinary hypoplasia of the chromaffine tissue. This finding was confirmed on a large material by Hedinger.³ The fact that the status lymphaticus renders the patient especially susceptible to accidents of narcosis led Schur and Wiesel⁴ to an experimental study of the effects of narcosis upon the chromaffine system. They found that the specific cells of the medulla of the adrenals showed a progressive loss of affinity for chromic acid salts, this decreased staining reaction becoming more marked as the time of narcosis lengthened until, after three to five hours of narcosis, no more chromaffine cells were found; synchronous with this loss of chromaffine substance was the disappearance of the mydriatic action of extracts of such adrenals on the enucleated frog's eye, and the disappearance of the iron chloride reaction. If the animals were allowed to recover from the narcosis, the chrom-reaction reappeared, the time of reappearance varying, until from eight to twelve hours later the cells possessed their normal affinity for the chromic acid salts. The extract of an adrenal after five hours' narcosis showed no physiologic effect in one experiment. The result was the same with either ether, chloroform, or Billroth's mixture.

Parkinson⁵ states that he found no chromic acid reaction in the medulla of the adrenals from two cases of postoperative shock.

Hornowski⁶ found in four cases of postoperative shock a condition similar to that reported by Parkinson. His experimental results are practically the same as those cited from the work of Schur and Wiesel. Hornowski's most interesting conclusions are the following: "Chloroform increases the need for tonic substance, and at the same time causes an exhaustion of the chromaffine system, which may cause death." "Chloroform does not cause an immediate exhaustion of the tonic substance, but grad-

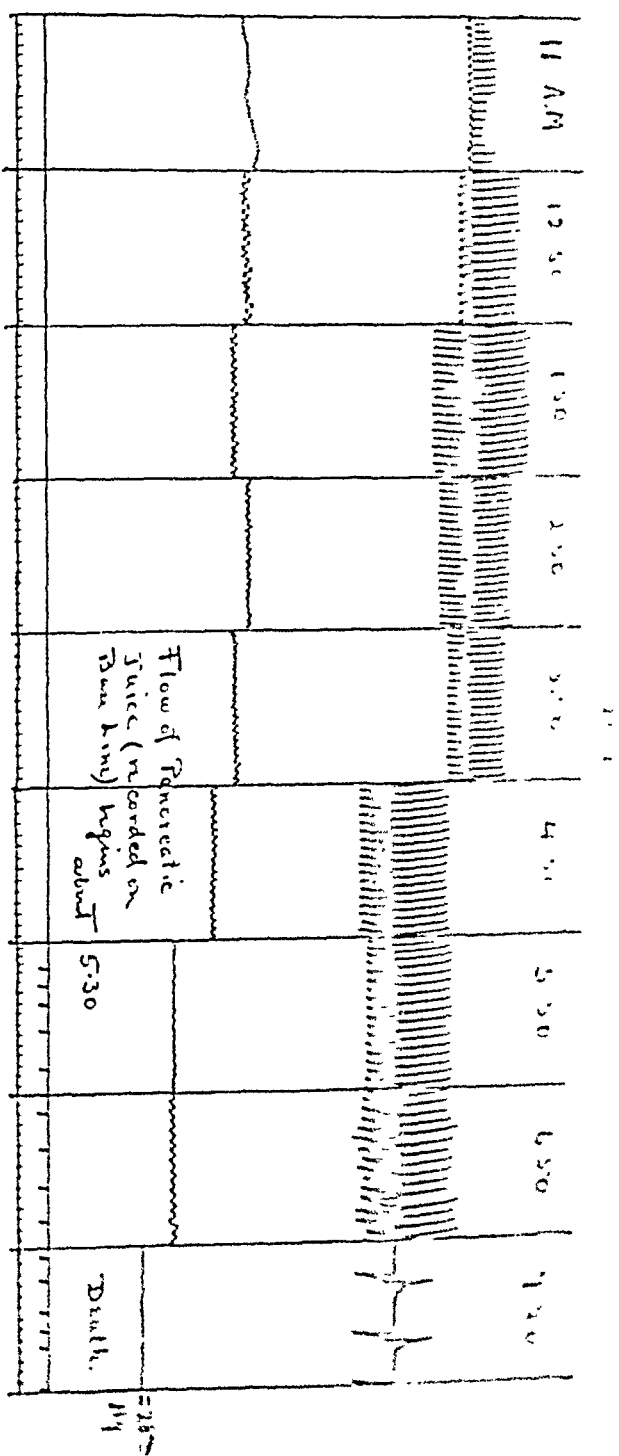
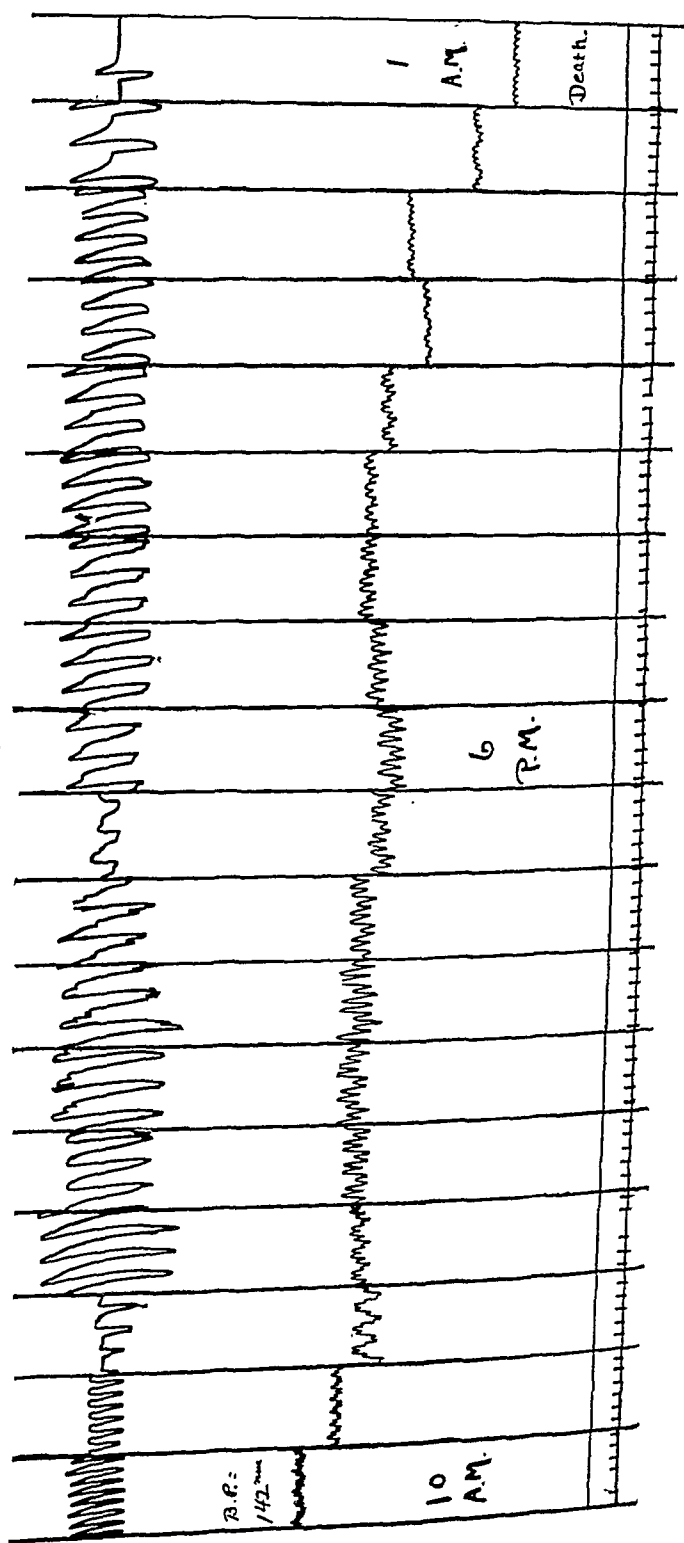


FIG. 2.



ually, after several hours." "Chloroform may cause a sudden exhaustion of the chromaffine substance if it be not present in abundance." "The resistance of the organism to surgical shock is expressed in the possibility of satisfying a greater need for tonic substance, and in the ability of the organism to secrete it."

Kostlivy ⁷ reports two cases, one of death occurring 72 hours after narcosis, in which the chromaffine substance was found intact; this result he explains in the sense of a regeneration, following Schur and Wiesel. A second case in which death occurred 24 hours after narcosis showed no demonstrable chromaffine substance.

Schwarzwalld ⁸ concludes from a study of ten cases of death during and after narcosis, in seven of which the chromic acid reaction of the adrenals was found intact, that the question of the integrity of the chromaffine tissue under the influence of narcosis does not possess decisive importance. It must be added, however, that in three of these cases fatty degeneration of the heart was noted, and a fourth was operated upon while in eclamptic coma.

Kahn ⁹ endeavors to prove by extensive experiments that the work of Schur and Wiesel is based upon untrustworthy technic, and that therefore their results are incorrect.

A fairly extensive series of tests with the enucleated frog's eye, carried out by Dr. Pemberton and myself in connection with another phase of our work, led us to a conclusion in full agreement with Kahn, that results obtained by this method are not dependable; yet the results seem sufficiently accurate to enable one to draw such a general conclusion as the one that narcosis affects the adrenals. At the same time it is also fair to criticize one part of Kahn's own work. He made extracts of the adrenals after narcosis and found that they always gave a positive physiological reaction, but he used no norm for comparison. It is in such experiments a question of the amount of pressor substance as compared with some normal standard, not of its absolute loss. Dr. Pemberton and I have often observed in the normal animal that the ether must be pushed beyond mere anaesthesia before an effect upon blood-pressure is obtained, so that five hours' narcosis may not have meant the same thing in the experiments of Schur and Wiesel and those of Kahn.

In reviewing the notes of the work with Dr. Pemberton, I find of our last ten experiments, in which special attention to the condition of the adrenals was directed at autopsy, nine are noted as having the gross appearance you will see in the Kaiserling preparations,—the medulla is darker in color than normal, and around the circumference of the medulla are hemorrhages which extend radially a slight distance into the cortex, giving the organ a striated appearance. In one experiment the macroscopic appearance is noted as normal. I have made a few extracts of such adrenals, and in one instance it was evidently much less active than an extract of the adrenal from a normal dog; in another no marked difference could be seen.

Nevertheless, in spite of the fact that part of the technic used by Schur and Wiesel has proved unsatisfactory in our hands, and that the reaction to chromic acid salts may be uncertain or at best may not necessarily show the condition of functional efficiency, I still feel that the facts brought out by Schur and Wiesel and Hornowski are correct. This feeling is based upon the results we have obtained by the use of entirely dissimilar methods.

The most satisfactory proof I have seen that narcosis affects the adrenals is, first, in a comparison of the curve of the blood-pressure of a dog under ether with that of a dog from which the adrenals have been removed. In both there is the same gradual, progressive fall of pressure, occurring sooner in the dog from which the organs were removed; the time of fall in the normal dog can be hastened by increasing the rate at which the ether is administered. And, second, in our study of the interrelation of the glands of internal secretion, Dr. Pemberton and I have found that the pancreas begins to secrete after the removal of the adrenals, and may show an astonishing secretory activity over a long period until the animal's death. This fact, together with the fact that adrenalin inhibits the flow of pancreatic juice which follows the intravenous injection of secretin, leads us to conclude that the adrenals exercise some sort of control over the pancreas. In the etherized normal dog

this flow has never appeared; but there may, and often does, occur in the last minutes of life after prolonged etherization a flow of pancreatic juice, which we are inclined to feel indicates that the adrenals have been so affected by the narcosis that they have lost their control over the pancreas,—in other words, that the adrenals are exhausted.

In all our experiments we have a continuous record from the beginning of the experiment until the end, of the respiration, the blood-pressure, and the time in seconds, as well as the flow from the pancreas whenever it occurred. The only characteristic feature, aside from the flow of pancreatic juice in those cases where it occurs, is the gradual but progressive fall of blood-pressure; in some instances where a valvular heart lesion was found at autopsy, the addition of ether may be seen to cause sudden falls of pressure, which may sometimes be immediately fatal.

It is in regard to this point that the experience and more careful observation of the surgeon is needed to a proper elucidation of the problem. It should be perfectly evident that a change in the adrenals would not be expected in every case of sudden death during or after narcosis. It is astonishing to note that Schwarzwald included three cases of fatty heart, and one of eclamptic coma. I am of the opinion that the term "shock" should be more strictly used, and should only apply to those cases where neither the case history nor an autopsy reveals any other cause of death save the progressive fall of blood-pressure.

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musculature to the action of the adrenalin may be variable, so that what would be a functional adrenalin content of the gland in one animal would not suffice to maintain the vascular tone of another.

Two points stand out from the somewhat indefinite condition of the problem of the relation of narcosis to the chromaffine system; first, the necessity for an accurate clinical classification of cases of death due to narcosis; second, the hope that a rational treatment of cases of shock—the prophylactic treatment—may soon be materialized.

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⁷ Casopis lekuv, 1909, Nr. 2, cited by Schwarzwald, Verhandlungen d. deutschen path. Gesellschaft, 1909, xiii, 268.

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⁹ Pflüger's Archiv, 1909, cxxviii, 519.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY.

Stated Meeting, April 27, 1910.

The President, DR. ELLSWORTH ELIOT, JR., in the Chair.

BONE METASTASIS IN A CASE OF HYPERNEPHROMA.

DR. E. H. POOL presented a man, 57 years old, who was transferred from the medical service of the New York Hospital to the service of Dr. Frank Hartley on February 15, 1910. For three months prior to admission he had suffered from moderate pain in the calf of the right leg. Soon after the pain began, he noticed a swelling just below the knee, which steadily increased in size. He had no symptoms referable to the abdomen or elsewhere.

Examination on admission showed a rounded swelling, about two inches in diameter, on the outer part of the right leg, over the head of the fibula. The skin covering it was slightly reddened, movable, and not tender. The tumor was rounded, smooth, and immovable, and evidently involved the head of the fibula. It gave a marked expansile pulsation; its size could be diminished by pressure, and the pulsation was controlled by pressure upon the popliteal artery. There was no thrill nor murmur. The knee-joint was normal; there were no enlarged inguinal nodes.

The heart was slightly enlarged, and there was a systolic murmur heard at the apex. The arteries were sclerotic. Physical examination was otherwise negative. The urine was clear, acid; specific gravity, 1010; it contained a trace of albumin and a few leucocytes.

opening the knee-joint and weakening the bone. The wound healed by primary union, and the patient could soon walk with comfort. The growth, which measured about one inch in diameter and was for the most part encapsulated, involved the whole head of the fibula; it infiltrated the muscles to a very slight extent, and at one point reached the head of the tibia. It was grayish-red in color, very vascular, and of soft consistence. The growth was submitted to Dr. Elser, who reported that the microscopical examination revealed the typical picture of hypernephroma.

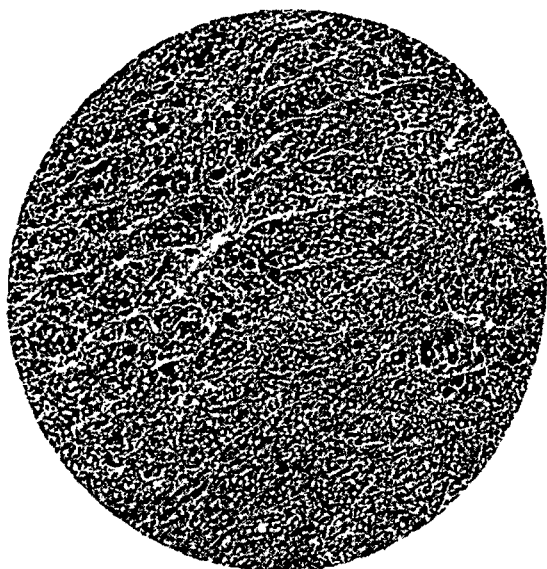
As a result of this report, renewed efforts were made to palpate the kidneys, but only a doubtful feeling of resistance could be made out over the lower pole of the right kidney. The X-ray failed to reveal anything abnormal, in or near the kidney. Cystoscopic examination of the bladder made by Dr. A. S. Taylor was negative. The ureters were catheterized, but the urines showed no notable differences: methylene blue, injected subcutaneously, appeared in the left urine in nine minutes and in the right in fifteen minutes, showing delayed secretion on that side. Red cells had been present in the urine in several subsequent examinations.

Exploration of the kidney was not done on account of the patient's poor general condition and his opposition to another operation. Weekly examinations since his discharge have revealed a rapidly growing tumor in the region of the right kidney, which was now very extensive. It was hard and nodular to the feel. The patient had lately begun to suffer from weakness, loss of appetite, and severe abdominal pains.

GANGRENE OF THE LUNG.

DR. JAMES M. HITZROT showed two patients. The first case was a man, 34 years old, a laborer, who was admitted to Dr. W. Gilman Thompson's service at Bellevue Hospital on February 16, 1910. He complained of shortness of breath and pain in the right chest, which was increased by breathing. Eleven days before admission he had suffered from severe shooting pains in the right chest, which kept him from work, had a dry cough, had expectorated a little blood, and felt weak and sick. On admission, his temperature was 103° ; pulse, 120, regular. There was dulness over the left lower chest, with bronchial breathing, but no tactile fremitus behind. Upon aspiration, a syringe of

FIG. 2.



Microphotograph of bone metastasis of hypernephroma.

GANGRENE OF THE LUNG.

brownish, stinking fluid was removed. A blood count showed 45,000 white blood-cells, with 79 per cent. polymorphs.

The patient was transferred to Dr. George Wood's Thoracic Operation, by Dr. Hitzrot: By aspiration, pus could only be obtained in the eighth interspace below the angle of the scapula. Under local anaesthesia, an incision was then made in the eighth rib, and three inches of the rib was removed, exposing a cavity containing stinking pus and broken tissue, which came out of the chest opening in large clots. Rubber drainage tubes were inserted.

Following the operation, the patient's temperature fell from 100° to 102°, falling to normal on the forty-first day. During this time, the wound had discharged foul sputum; it ceased on the forty-fourth day, and now, seven days after the operation, it had healed excepting for a slight indentation in the skin. The open-air treatment on the balcony of the hospital followed throughout his illness. Cultures from the chest showed streptococci.

Dr. Hitzrot's second case of gangrene of the lung was that of a man, 34 years old, who was admitted to Dr. Thompson's ward in Bellevue Hospital on February 11, 1910, complaining of pneumonia. Three weeks before admission the patient had experienced a severe pain in the left chest, with a chill, and a dry cough. Instead of improving, he had gradually grown worse during the past week. His cough had become loose, and the sputum was profuse and very foul smelling. The pain in the chest had also become more severe, and he now had pain over the lower back on the left side, especially to the touch.

On admission, the patient's temperature was 101°; respirations, 40; pulse, 140. He was cyanosed and expectorated large quantities of foul-smelling fluid which separated into characteristic layers. His breath was extremely fetid, the odor of it filling the entire ward. Expansion was limited over the entire left back, with flatness below, and diminished vocal sounds over the flat area. Splashing was elicited by percussion of the patient. The chest was aspirated in the eighth interspace below the left scapula, and a syringe of sterile air was introduced. Pus and air were removed.

The patient was transferred to Dr. Wood's ward, where he was operated upon by Dr. Hitzrot under local anaesthesia.

three inches of the eighth rib being resected. The submuscular layer was filled with stinking pus, and a perforation in the pleura between the eighth and ninth ribs gave vent to foul fluid and air. The pleura was incised, and a large quantity of broken-down lung tissue and fluid of a very foul odor was allowed to escape. With each respiration, air entered the chest, and the finger could just reach a fairly large bronchus, the touching of which caused a paroxysm of coughing.

Numerous counterincisions were made to drain the submuscular space. Following the operation, the patient's temperature ranged between 100° and 103° , falling to normal on the forty-eighth day, at which time the discharge had ceased. Potassium permanganate solution introduced into the chest was coughed up immediately. The wound had now healed, excepting for a slight sinus, through which air escaped, especially on coughing.

Smears from the fluid showed a varied bacterial flora, among which were numerous *streptothrices*. The culture was unfortunately lost. No tubercle bacilli were found in either case, and both showed a chest exudate originating from a necrotic process in the lung, probably postpneumonic. In the second case, this connected with a large bronchus. The diagnosis of gangrene rather than abscess was based upon the foul character of the exudate, and the sloughing cavity in the lung.

DR. GEORGE WOOLSEY said a particularly interesting feature in both of these cases was the improvement that followed the balcony treatment—keeping the patients in the open air. In that environment they felt and looked better, their temperature dropped, and at the present time, from the appearance of the patients, they seemed to be in the best of health.

EXCISION OF THE RECTUM FOR CARCINOMA BY THE PERINEAL ROUTE.

DR. CHARLES H. PECK presented two cases to show the local result of resection of the rectum by the perineal route. In neither case was the condition in a sufficiently early stage to give much hope of an ultimate cure of the disease. In the first case, a deeply ulcerated growth which had already extended into the perirectal tissues posteriorly was discovered in the course of an examination for another condition, namely, right hydronephrosis, with movable kidney, and careful questioning showed that

rectal symptoms had been present for many months. A further delay of two months was caused by the patient's refusal to submit to operation. In both cases the growth was low in the rectum, so that the only difficulty of carrying the dissection wide of the disease was in its immediate vicinity.

The first patient had little or no true control, as the low position of the growth necessitated the sacrifice of a large part of the sphincter, but a constipated habit kept her from soiling excepting after catharsis. She was 60 years of age, and was operated on at the French Hospital on October 27, 1909. The technic was essentially that described in detail in the two cases presented to the Society by Dr. Peck in November, 1909. Ulceration had extended practically through the rectal wall posteriorly, and there was some leakage before the growth could be excised, in spite of careful manipulation. About five inches of gut was removed, including the posterior portion of the sphincter. The tape ligature was left on the proximal segment after the usual anchorage within the denuded sphincter and wound closure. No leakage occurred for sixty-six hours, when the insertion of a trocar to allow the escape of gas became necessary on account of distention, and the following day the ligature was cut away.

The wound healed slowly, with but slight infection, and the patient left the hospital on December 20. Dr. Peck did not see her again until April 25, six months after operation, when examination showed a well-marked cicatricial stricture just above the anal orifice, and a suspicious nodule posteriorly, where the growth had originally invaded the perirectal tissues. She had gained a good deal in weight, and her general condition had greatly improved. The local result was far from ideal, but still it was a marked improvement over her condition at the time of operation.

were invaded, and there was some adhesion to the vaginal wall. The growth and glands, together with from an inch and a half to two inches of healthy gut above the growth, were excised. The technic of the operation was similar to that already described. The growth proved to be a very cellular adenocarcinoma, with glandular involvement.

Healing was prompt, with practically no wound infection. The gut was left closed ninety-two hours, when spontaneous leakage occurred at the anal margin, and the tape was cut away. The patient left the hospital thirty days after the operation with the wound perfectly healed, and with some degree of sphincter control already established.

The ligation of the gut, Dr. Peck said, was a distinct aid in avoiding wound infection. The fact that it prevented suture of the mucous membrane to the anal margin, and that the sloughing of the projecting portion was apt to extend a little above the sphincter posteriorly, probably added to the danger of anal stricture to some extent, but that had not been an especially troublesome feature in the cases which he had done, the most marked example among them being Case I, presented at this meeting. In a third case done within the past few months, in which the growth was higher up, sloughing of several inches of the gut necessitated a second operation for the formation of a permanent inguinal anus.

PERFORATING DIVERTICULITIS OF THE SIGMOID.

DR. HOWARD LILIENTHAL showed a man, 45 years old, who was admitted to the Mt. Sinai Hospital on March 23, 1910. His past history had no bearing on his present illness, which began about eighteen months ago, when, soon after a meal, he had a feeling of distention of the abdomen, especially in the left iliac region. At that time he was confined to bed for several weeks and had a slight elevation of temperature. A mass of considerable size was felt in the left iliac region, which gradually disappeared. It recurred, however, and at the time of the patient's admission to the hospital it could be distinctly made out. It was quite hard, and adherent to the abdominal wall. The patient's temperature at this time ranged between 101° and 102° , and he did not have the appearance of a very sick man. The intra-abdominal growth was regarded as an abscess, probably a diverticulitis, or a slowly developing perforation in the wall of the sigmoid.

Operation.—An incision was made through the left rectus rather low down, exposing the sigmoid, the upper portion of which was very much congested and thickened. It was tied down by a large omental mass, in separating which he encountered a small abscess cavity containing very foul pus. He separated the omentum and removed a considerable part of that portion which had been adherent to the sigmoid, coming down upon two very well marked diverticula; one of these was quite long, and communicated with the abscess. Several other diverticula were present but they were not inflamed.

The entire coil of intestine was so much thickened and so friable that it was thought wise to partially exclude it. A side-to-side anastomosis was made, and the diseased loop of intestine was side-tracked, and the wound drained through the flank. The patient made a good recovery, and the flank wound which communicated with the inflamed loop of intestine healed almost immediately.

The interest of this case, Dr. Lilienthal said, aside from its being a case of diverticulitis which was diagnosed beforehand, lay in the manner of dealing with it. The damaged loop of intestine might have been excised, but that would probably have been a dangerous procedure under the circumstances. The speaker believed that the lateral anastomosis had much to do with the patient's prompt recovery. From the location of the anastomosis, and from the fact that the drainage opening to the diseased coil closed so rapidly, he was convinced that the anastomosis was now carrying on the principal work of the intestine and was draining the diseased part.

DR. ROBERT T. MORRIS asked Dr. Lilienthal whether the incision he had made in this case gave him the best access to that region. Personally, he preferred a gridiron incision, corresponding to the appendix incision on the right side.

Some of these cases, Dr. Morris said, might be treated conservatively. In one case where he was called upon with a view to operation, the patient had a large, distinct mass of exudate, but as he was apparently improving, it was decided to wait, and at the end of three weeks the mass was absorbed. In another case where the patient suffered from a dilated heart without compensation, there was a large intra-abdominal exudate which became absorbed without abscess formation. In all probability,

the speaker said, exudates in this region underwent absorption rather more safely than in some other parts of the abdominal cavity, although waiting for absorption was not to be advised, because the original defect would be left after recovery from any one acute attack. There were unusual reasons for waiting in these two cases quoted.

DR. LILIENTHAL, in closing, thought the case might have been cured without resorting to a lateral anastomosis, but at the same time the appearance of the intestine was not particularly favorable, and there were two or three areas that looked as if they might perforate. At any rate, it appeared to him that a lateral anastomosis promised the best drainage. The anastomosis was completed very quickly, taking only a few minutes, and ample drainage was thus afforded to the abscess and to the damaged loop of gut. As to the choice of incision, Dr. Lilienthal said that in approaching the sigmoid he usually went through the rectus; he preferred this to the gridiron incision, which was too far to one side.

A CASE OF CIRRHOSIS OF THE LIVER IN WHICH THE TALMA OPERATION WAS DONE NINE YEARS AGO.

DR. GEORGE WOOLSEY showed this case. The patient was a man, 68 years old, who was operated on in 1901, nine years ago. About five weeks prior to his admission to the hospital at that time he had noticed increasing swelling of the abdomen, with some difficulty in breathing. The arteries were slightly thickened; his appetite was good. Upon examination, the liver could be felt three and a half inches below the ribs; the spleen was not palpable. The abdomen at the umbilicus measured 110 cm.

Upon opening the abdomen, the liver was found hob-nailed; the omentum was thickened, and the superficial abdominal veins distended. The abdominal cavity contained a large quantity of fluid; this was evacuated, and the omentum was sutured to the peritoneum, the typical Talma operation being done. A second opening was made above the symphysis for drainage.

After the operation, there was a reaccumulation of fluid, necessitating three or four tapplings, but at increasing intervals. Finally, there was no further reaccumulation of fluid. The patient resumed his occupation and was able to work until September, 1909. He was then in Florida, and had a severe attack

of malaria. About this time his abdomen again became swollen, with increasing shortness of breath and loss of weight and strength. Paracentesis was performed and had been repeated several times since.

Dr. Woolsey said the interest in this case lay in the fact that this patient had enjoyed such a long period of immunity from a recurrence of his ascites, namely, from April, 1901, to September, 1909.

DR. LILIENTHAL said that a few days ago he was asked to operate on a case of supposed cirrhosis of the liver, of which the patient gave every evidence. The belly was enormously distended with fluid. There was no jaundice. Upon opening the abdomen, he came down upon an extremely contracted liver, which was evidently carcinomatous. The abdominal cavity was filled with a straw-colored fluid *not* in the slightest degree bloodtinged. After removing a small specimen from the liver, the wound was closed, and the man died a few weeks later. The fluid in this case, Dr. Lilienthal said, was collected in order to use it in other cases of carcinoma, after the manner suggested by Hodenpyl. The case was one of primary carcinoma of the liver, involving the liver-cells, and the entire liver was carcinomatous from one end to the other. The organ was very much contracted, and the carcinoma was probably on a cirrhotic base. The spleen was not involved. Cases of this kind were very unusual.

THE TREATMENT OF LARGE ANEURISMS WITH GOLD WIRE AND ELECTROLYSIS, WITH REPORT OF A CASE: EXPERIMENTAL RESULTS.

DR. WILLIAM C. LUSK read a paper with the above title.

DR. WOOLSEY said he did not understand the advantages of the gold wire over an alloy of silver and copper. In one case (reported in Vol. xxxii) where he had employed this method with a somewhat stronger current, the patient had three aneurisms, and the wire was introduced into the middle sac, which was the largest of the three. A clot was readily produced, but as this contracted, the blood again had free access to the outer or traumatic sac and the man ultimately died from rupture of this sac. What was desired in these cases was to get an adhesion of the clot to the aneurismal wall; otherwise, when the clot contracted,

there was a space between the clot and the wall. Such adhesion did not occur except when the intima was altered by the current passing through the wire where it was in contact with it.

DR. ELIOT asked Dr. Lusk if he had ever found any indication of embolism resulting from any method of treating aneurism, either by ligation or electrolysis.

DR. LUSK replied that a case of embolism following the wiring operation had been reported by Salinger.

CONGENITAL MACRODACTYLIA.

DR. POOL showed the specimen in this case, upon which he operated at the French Hospital in June, 1907, for macrodactylia and diffuse lipoma of shoulder and arm. The patient was a boy, 2 years old, who was born with a very large right index finger. When the child was about 18 months old the mother also noticed enlargement of the right arm and shoulder.

Physical examination showed a healthy boy, normal in every respect excepting the right upper extremity. The outer parts of the shoulder, arm, and forearm were greatly enlarged by a diffuse lipoma. The index finger was about twice the normal size, the nail being correspondingly enlarged. These features were shown in the photographs.

The index finger was removed at the metacarpophalangeal joint, and the most conspicuous parts of the lipoma were excised through elliptical skin incisions. Its outlines, however, were nowhere distinguishable. The wounds healed by primary union, and the boy was greatly improved in appearance.

Histological examination showed the tissues removed from the shoulder and arm to be lipomatous. The notable features in the examination of the finger were marked increase of subcutaneous fat and considerable increase in the breadth of the terminal phalangeal bone.

EPITHELIOMA OF BOTH UPPER JAWS AND MUCOSA OF UPPER LIP: RESECTION OF BOTH UPPER JAWS.

DR. L. W. HOTCHKISS reported this case and showed photographs illustrating the condition before and after the operation. The patient was a male Italian, 26 years old, who was admitted to Bellevue Hospital on February 9, 1910. His previous history was unimportant. About two months ago he first noticed a stiff-



ness and thickening of the upper lip on its mucous aspect. At this time there was practically no pain. The swelling seemed to involve the gums, especially at a point where he had had three upper front teeth removed some years ago. Here there was slight swelling and some pain, and this point finally broke down into an ulcer, which gradually increased in size, involving the gums about the outer teeth, which fell out. The ulcer had been slowly increasing in size and involving more of the hard palate; it bled very readily, had a foul odor, and recently the pain at the site of the ulcerated area had been severe. The patient also complained of an almost continuous headache and pain in the back of his neck, with some stiffness. His appetite had been poor, and he had lost considerable weight, as he had been unable to eat on account of the condition of his mouth. The patient's general appearance was anæmic and wretched, the upper lip bulging, and the mouth emitting an extremely offensive odor. The growth bled very easily, and a considerable hemorrhage took place from the excision of a small bit of the tissue for microscopic examination.

Operation (February 19, 1910).—Ether anæsthesia was employed, preceded by a small hypodermic of morphine and atropine. Drop ether with the mask was first used, and later the anæsthetic was given by Crile's method through nasal tubes. The usual Ferguson incision for the removal of both upper jaws was made, and the greater portion of the bodies and processes of both bones were removed, excepting the orbital plates. There was moderate hemorrhage, and no preliminary carotid ligation was done. The hard palate as far back as the palate process of the palate bone, a portion of the septum of the nose, and the lower turbinates were taken away, as well as most of the body of the bone. The affected mucosa of the upper lip was also excised, and the soft parts were brought together by silk sutures and covered with a layer of cotton and collodion dressing. The patient bore the operation well, considering his enfeebled general condition, and his convalescence was uneventful, barring the occurrence of a mild erysipelas of the nose and the adjacent part of the face.

There was only slight elevation of temperature after the operation; the patient rapidly gained in strength under systematic nasal feeding and he was soon up and about the wards. The power to hold food in the mouth and swallow without leakage

through the anterior nares was rapidly regained, and when he left the hospital on March 30, forty days after the operation, he could feed himself and eat solids and liquids with but very slight leakage. By this time the large cavity left by the operation had contracted considerably, and the deformity, as shown by the photographs, was very slight.

The patient was removed from the hospital by the authorities to be deported to Italy, so it would be difficult to find out how long an interval would elapse before a recurrence took place. It was certain, however, that the removal of the huge and foul, ulcerating mass from his mouth made him at least more comfortable. The photographs illustrate very well the situation and extent of the epitheliomatous growth, and the comparatively small deformity resulting from so extensive and mutilating an operation.

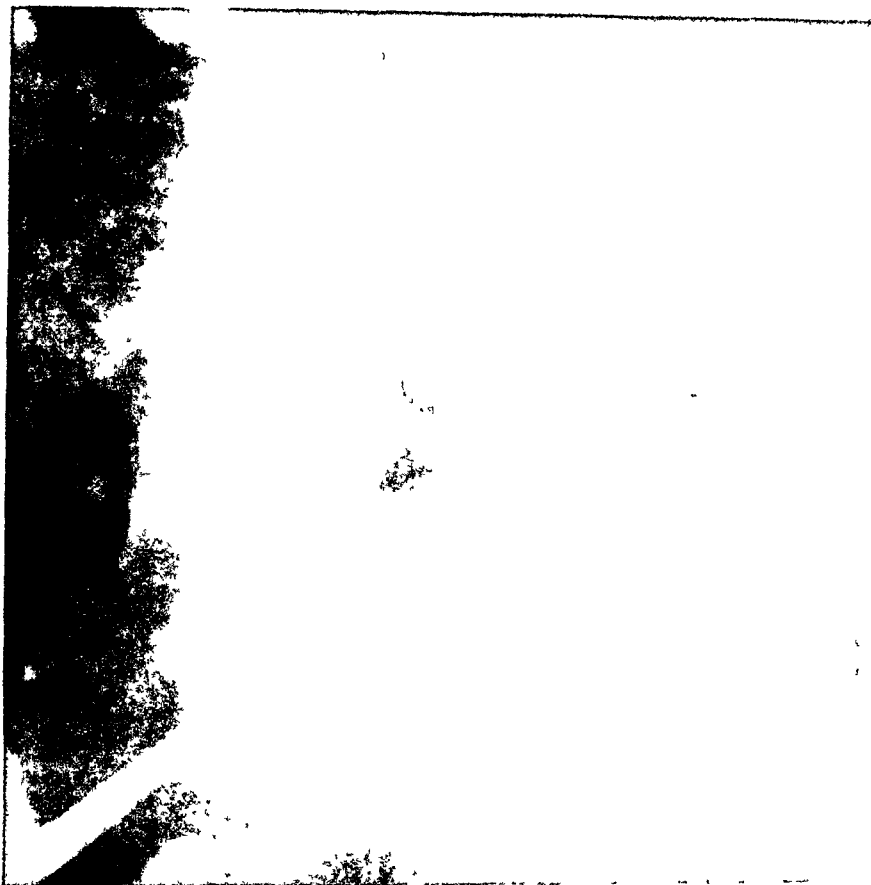
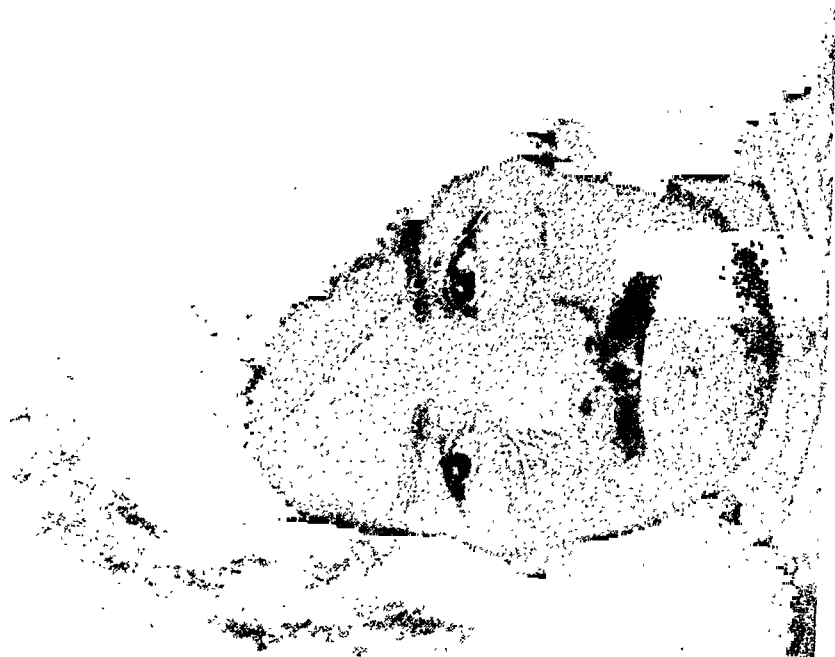


FIG. 5.



Showing cosmetic result after removal of both upper jaws.



TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY.

Stated Meeting held April 4, 1910.

DR. ROBERT S. LECONTE, President, in the Chair.

EPULIS AND SARCOMA OF JAW.

DR. JOHN M. SPEESE read a paper with the above title, for which see page 493.

DR. W. M. L. COPLIN (by invitation) said with reference to melanotic tumors of the jaw that he had seen specimens from a number of these cases and did not know of a single one in which recurrence did not take place. Dr. Speese spoke of the prognosis based on histological examination. This may be possible if the tumor contains many giant cells, but when dealing with neoplasms composed of round or spindle cells the method becomes of doubtful value; it is probable that in these cases the outcome depends largely upon the resistance of the patient. Usually the paramandibular tissues are not involved early, a fact depending upon the architecture of the jaw, the periosteal and intra-osteal tissues acting as a filter that resists extension of the growth.

Another point worthy of attention is the relative immunity of the submaxillary and sublingual glands. Of the specimens which come to the laboratory for examination, he had seen one in which either a submaxillary or a sublingual gland was extensively invaded. He had seen the growth almost surround a salivary gland but for some reason or other it is rare to see it penetrating the lobes or even the interlobular tissues. In all neoplasms of the mouth the salivary glands are attacked late, if at all. He had never seen a telangiectatic sarcoma of the jaw in which there has been extensive ulceration, a fact for which a fully satisfactory explanation is wanting. The jaw enlargement is accomplished by internal osseous absorption and continual subperiosteal apposition. He had one specimen removed by Professor Hearn in which the involved area of the jaw was larger than

a fist, and still there was no sign of extension through the outer bony layer and no involvement of the soft parts; this tumor presented egg-shell crackling in a very marked degree.

DR. A. P. C. ASHHURST inquired whether Dr. Speese had succeeded in following any patients treated by radical operation. It has been claimed by recent writers that it is useless to do a radical operation as the disease, if highly malignant, recurs in a few months and the patient dies; whereas an operation consisting in an evacuation and scraping of the tumor is sufficient in cases which are not so malignant.

DR. JOHN SPEESE rejoined that the diagnosis in most of the cases operated upon at the University Hospital had been made from the clinical appearance of the tumors, although in some instances frozen sections had been made when the growths had been soft and not infiltrated with lime salts or bone. In the central sarcomata, in three or four cases, the bone was trephined and sections taken for microscopic examination, the operative procedures being based upon the character of the growth, the giant cell tumors being treated by less radical measures than other types of sarcomata.

His experience agreed with that of Dr. Coplin for the salivary glands had been involved rarely in malignant disease of the mouth and jaw. Their records show that many of the periosteal and central sarcomata, both round and spindle cell in type, have been cured. The number of cases traced through the Surgical Laboratory does not permit him to state at present, however, the percentage of cures in the cases operated upon.

ENTEROPTOSIS.

DR. GEORGE P. MÜLLER reported a number of cases of enteroptosis, and remarked that the abdominal organs are held in position by the negative pressure of the thoracic cavity, the mutual support of the different organs, the peritoneal, ligamentous and vascular attachments, etc. If these are interfered with, ptosis will result, and such interference may occur from congenital or acquired causes.

The congenital type is usually seen in a thin, pale, young woman, of slight build, with a long sunken thorax, flabby abdominal walls, a juvenile expression and a bodily form exactly like that seen in the tuberculous. The tissues are inherently weak and fragile and the actual displacements occur from secondary causes

such as exhausting diseases, marked loss of weight, overstrain, lack of proper nourishment, constricting clothing, pregnancy, uterine affections, prolonged cough from bronchial affections, etc. The earlier manifestations are seen in the attacks of dysmenorrhœa and chlorosis that young girls experience and later the symptoms may be erroneously interpreted in such vague terms as neurasthenia, nervous exhaustion, chronic constipation and change of life. There is no essential difference between the symptoms due to a movable kidney, a retroverted uterus or a displaced colon except those dependent upon the drag on different anatomical supports, the general phenomena being the same.

The symptoms are referred to the digestive apparatus, the generative organs, the nervous system, or to the body generally; gastric hyperacidity, flatulence, constipation, vague abdominal pains, backache, pelvic troubles, leucorrhœa, headache, menstrual and vesical troubles, melancholia, nervousness, etc., are the most prominent symptoms and the patient complains of a total lack of energy, physical and mental. There is a lightness of weight and a general relaxation and flabbiness of the tissues.

Physically, the oblique slant of the ribs, the acute epigastric angle and the very long abdomen and small waist are characteristic. The tenth rib may be freely movable or floating (Stiller's sign). One or both kidneys are often palpable, the liver is displaced and its edge palpable, the stomach displaced and may be dilated, the colon and sigmoid are usually displaced and often redundant, the uterus may be retroverted or flexed.

A movable cæcum may produce symptoms indistinguishable in many cases from true appendicitis and Klose believes that in many of the cases of recurrence of trouble after operation without supposed chronic appendicitis a movable cæcum is at fault.

The *acquired type* is due (1) to rupture of the pelvic diaphragm from childbirth which, if extensive and not properly repaired, may after a time weaken the abdominal supports and not only the uterus but the intestines may become displaced; (2) to constipation, which by overloading the colon or sigmoid may directly induce ptosis; (3) by tight lacing which tends to force the intestines downward and loosen the liver; (4) to adhesions from inflammatory disease or from operations causing a drag upon the omentum, and by direct traction the colon is pulled downwards, and drawing upon the stomach it in turn is displaced.

No case of enteroptosis should be operated on until medical means have been exhausted without relief. The patient should be treated, if the displacement is of the congenital type, in exactly the same way as are tuberculous patients, and the outdoor life should be especially emphasized. The diet should be carefully regulated and food causing flatulence or constipation avoided. Certain drugs, especially tonics and laxatives, may be needed at times, but are of minor importance. The abdomen must be supported by an efficient bandage, and it is well to advise elevation of the pelvis for an hour or more before retiring. If the patient is young and the thorax movable she should be taught a system of breathing exercises in order to increase the capacity of the lungs and the size of the upper abdomen.

The question of when to operate is difficult to answer in the congenital type. In general, it may be stated, that if some one organ is markedly ptosed and the symptoms are especially referable to this organ, an operation should be advised, but if the kidneys, stomach, colon, uterus, etc., are all displaced and the symptoms general, operation only complicates the condition, and as Clark has said, "A pathologic condition may be left behind which imposes a still greater burden upon the defective dynamo and makes a more hopeless neurasthenic of the patient than ever."

The acquired cases, on the other hand, offer splendid opportunities for conservative surgery, the type of operation depending upon the condition causing the ptoses. Repair of the perineum, suspension of the uterus, shortening of the uterosacral ligament, suspension of the colon, of the stomach, and of the liver, are the operations most commonly practised. In addition to these the separated recti should be brought together by some operation such as Webster's. A large part of the fat may be excised from a pendulous abdomen, as recently practised by Howard Kelly, or the oblique muscles may be strengthened by some such operation as the one recently published by Coffey. In recent years a number of operators have proposed excision of part or all of the colon. Dr. Müller commends the excision of most of the transverse colon or of the sigmoid in selected cases as it undoubtedly will be frequently performed in the future, but believes that Lane's proposal to excise the entire colon and anastomose the ileum to the sigmoid is unnecessarily severe and certain of a high mortality. The operation of iliosigmoidostomy with exclusion of the

colon is not rational and will probably fall by the wayside, the experimental work being decidedly against its value.

Finally, he urged the necessity for caution in these cases, as too much operating can easily be done and the results if bad are almost irremediable. The surgeon should endeavor to grasp the salient points in the cases, repair the major lesion and trust to his after-treatment to finish the cure of his patient.

DR. WILLIAM L. RODMAN said with regard to gastropotosis, he personally had believed it unwise to operate on the majority of these cases, yet there are exceptional ones demanding operation. He had recently encountered such a case in a patient referred to him by Drs. Anders and Pfahler. The patient was a small woman and the degree of dilatation and displacement of the stomach was so marked that the medical men considered that the case required operation. She vomited constantly, being unable to keep anything on her stomach. Dr. Pfahler had skiagrams made several years ago and some made more recently, indicating that the stomach was twice or thrice the size it should be. The stomach was so large that it was in the pelvis; this naturally produced a kinking at the pylorus, and interfered with the organ emptying itself. It seemed that nothing short of a pylorectomy would do any good. Between one-third and one-half of the stomach was removed and the remaining portion sutured to the parietal peritoneum or anterior abdominal wall. There has been a skiagram taken since the operation, a day or two before she left the hospital, which shows now the remaining part of the stomach in good position. She has not vomited since the operation; she is putting on flesh. This is one case in which operative interference was undoubtedly warranted.

We probably have been remiss in the past in not operating on more of these cases. Undoubtedly, however, the old rule that where there is general dropping of all the viscera operation is not indicated, holds good; but, where the ptosis is limited, operation is both desirable and advisable.

CHROMO-URETEROSCOPY IN FUNCTIONAL KIDNEY DIAGNOSIS.

DR. B. A. THOMAS read a paper with the above title.

Dr. Thomas further remarked that in chromo-uretero-

copy it is desirable to insure a perfectly colorless fluid content of the bladder, and he believes this, in many instances, can be obtained only by prolonged irrigation. In bad cases of hæmaturia or pyuria it becomes positively essential. This can best be obtained and maintained by an evacuation cystoscope which permits of frequent and speedy evacuation and refilling of the bladder, because very frequently the bladder content may become clouded and it will be impossible to judge as to the character of the elimination of the dye. An absolutely brilliant illumination is necessary so that the landmarks in the bladder as well as a weak color reaction will be distinctly visible. If these two conditions are not secured, in certain cases where there has been chronic retention of urine or chronic parenchymatous nephritis, in which diseases the elimination of the indigo as a light blue will simply ooze out of the ureteral orifices instead of being ejected as a spurt, judgment of the test will be vitiated and conducive to erroneous conclusions.

It would be of value to one undertaking the work for the first time to have the history and know the physical examination of his case. So far as the results of the cases here reported are concerned, Dr. Thomas refers the questioner to a careful review of the charts, noting the time of elimination and color reaction in detail, for it was with respect to these observations alone, to prove their value or worthlessness, that the charts were compiled.

Annual Meeting held April 25, 1910.

The President, DR. RICHARD H. HARTE, in the Chair.

THE RELATION OF DUCTLESS GLANDS TO SURGERY.

DR. J. EDWIN SWEET read a paper with the above title, for which see page 545.

DR. W. M. L. COPLIN (by invitation) said that recently Caccio has published in Italian a paper on cellular lipoids in which he deals with the influence of the chromic acid salts on these bodies and suggests very strongly that there is some relation between chromaffine substance and the lipoids contained within certain tissue cells. Admitting the correctness of views which Dr. Sweet has given, concerning the influence of anæsthetics, then there is a chemical explanation for the observation brought for-

ward in his paper. If these substances are soluble in the agents used in anæsthesia, then, of course, one at once appreciates why they become so readily diffused, and why under such circumstances exhaustion of the lipoid-producing cells would be more rapidly established under the influence of agents which are in a way solvents of such bodies. One of the most interesting thoughts with regard to these observations is the suggestion that the solubility of some of these constituents of cells appears to be much greater during life than postmortem; the abstraction of these agents by known bodies in which they are soluble would seem to be accomplished less rapidly and less effectively from the excised or dead organ than occurs by circulating through the structures media containing anæsthetics or other substances which are solvents for the lipoids. This might be interpreted as indicating that the change was partly metabolic and not purely chemical. If the stage which is now considered dependent upon excitability after the administration of an anæsthetic is really due to the abstraction of pressor substances from the adrenals or other structures then a new point of view is obtained.

ANNUAL ORATION.

DR. ASTLEY P. C. ASHHURST delivered the Annual Oration entitled "The Patience of Surgery."

BOOK REVIEWS.

DUODENAL ULCER. By B. G. A. MOYNIHAN, M.S., London, F.R.C.S., Senior Assistant Surgeon at Leeds General Infirmary, England. 8vo, 379 pages. Philadelphia and London: W. B. Saunders Company, 1910.

It would seem that during the centuries that have elapsed since human anatomy really began to be studied but little would have remained undiscovered in this particular domain. As a matter of fact, this is not the case, for each new volume that appears contains important discoveries even in the gross anatomy of the body, and the minute anatomy of some of the organs is still a sealed book.

Our knowledge of the appendix and its surgical diseases is relatively recent. All of the abdominal viscera in turn have been subjected to radical operations for the relief and cure of disease and it would seem that little remained to be accomplished.

Within the last year, however, the pancreas and the adjacent hollow viscera have been studied more and more, and it has been the good fortune of the writer of the present volume to elaborate and report a series of clinical studies and operations performed upon the duodenum, which it is safe to say will in the future be regarded as important as the work done in the early eighties by McBurney, Fowler, and other surgeons whose names are especially associated with the operations for appendicitis.

Anatomical knowledge of the duodenum is still far from complete. It is a matter of historic interest that Morgagni described a diverticulum of the duodenum for the first time in 1761, and one or two other specimens were casually reported in the century which followed. The Editor of this journal, Dr. Pilcher, described "A Large Pseudo-diverticulum of the Duodenum" in 1894 and redirected attention to this viscus. In this case the duodenum opened into the sac, and from the sac the jejunum passed. The sac presented mucosa in only one small strip. Elsewhere the parietes were devoid of epithelial lining and exhibited inflammatory changes.

In 1904, Good collected five specimens. Two of these received mere mention. For twenty years few other facts have

been recorded, but within the last year or two, Dr. Wesley M. Baldwin, of the Cornell Medical School at Ithaca, has dissected and demonstrated a remarkable series of cases. As a result of casual findings in the dissecting room, Dr. Baldwin became convinced that diverticula of the duodenum were more common than is generally supposed. He carefully examined the duodenum in 105 consecutive cases, and the result of his investigations showed fifteen true duodenal diverticula. One duodenum presented two diverticula. All of these diverticula were situated upon the left or concave side of the duodenum extending towards the pancreas. Four projected directly into the gland, eight lay behind, while the other three were caudal to the head of the gland. None of the diverticula presented any evidence of inflammatory conditions. All of them belonged to the "true" variety.

Exclusive of this Cornell series, there are reports of only 67 specimens of duodenal diverticula available in medical literature. This figure, however, does not in any way represent the frequency with which these anomalies occur, for, as a matter of fact, the duodenum is rarely carefully examined at the routine autopsy, and still less frequently has it been the subject of surgical intervention.

It is the good fortune of the writer to have seen all of the specimens which Dr. Baldwin has so carefully prepared, and it was evident that many of them, forming pockets within the substance of the pancreas or extending behind the duodenum with an opening often of a size which would barely admit a probe, must be the cause of various disorders of this portion of the intestinal tract not hitherto recognized in a clinical way. The full report of this interesting series will be found in the *Anatomical Record* in the course of a few months.

This opinion as to the surgical importance of this condition is substantiated by the extraordinary work done by Dr. Moynihan, for there is little doubt that many of the ulcers which he found in his operations started primarily in a duodenal diverticulum.

Ten years ago ulceration of the duodenum was looked upon as a rare disease, and its confident recognition during life was believed to be hardly possible. To-day, largely as a result of Dr. Moynihan's personal observation, it is known to be a common disease and its diagnosis in the majority of cases presents no great difficulties. Indeed, the author states that in his experience, the diagnosis of duodenal ulcer is made with a degree of accuracy that is not exceeded in the case of any other abdominal disorder.

In the book itself the preliminary chapters are devoted to a consideration of the various forms of ulceration of the duodenum. "Curling's ulcer," which often follows extensive burns and scalds of the body, appears to be the most common form due to external traumatism. Uræmia, tuberculosis, or chronic nephritis play an important rôle in the etiology of this affection, and in the newborn, melena neonatorum often arises from ulceration and bleeding from this portion of the bowel. These affections are clearly described but are relatively unimportant when compared with the type of chronic duodenal ulcer which existed in the majority of cases coming under Dr. Moynihan's care.

The symptoms of this type of ulcer are definite; are easily mistaken; and appear in an order and with a precision which are indeed remarkable. Most patients give a clinical history which is of itself of the greatest importance in diagnosis. Physical signs as a rule rarely can be elicited by abdominal palpation. When bleeding occurs as evidenced by hæmatemesis or melena, the prognosis is much more grave than any similar bleeding following ulceration of the stomach. Quite characteristic is the fact that pain, instead of occurring immediately after the ingestion of food, begins three or four hours later at a time when the stomach is practically empty and about the time when the patient begins to feel hungry for his next meal.

The chapter, Symptomatology, is one of the most important in the volume and should enable any one thoroughly familiar with it to make an accurate diagnosis. It is worthy of note that the so-called acid dyspepsia is practically synonymous with this disease, but as a matter of fact, hyperacidity rarely if ever exists. In some aggravated cases which had extended over years, a test of the stomach contents showed little more than half of the normal acidity.

The treatment is essentially surgical in character. No records exist of operations performed after the primary attack, but after the second attack, a number of cases have been operated and the diagnosis confirmed. Four methods of treatment are open to the surgeon: first, excision of the ulcer; second, gastro-enterostomy; third, resection of the duodenum with or without the pyloric portion of the stomach; and fourth, resection and end-to-end anastomosis, the pylorus being left intact. Each of these operations is clearly described, and the illustrations which are well executed add materially to the value of the text.

Perforation is a complication which frequently occurs in the

later stages of the disease, and its possibility should be borne in mind in all cases in which the appendix, the gall-bladder, or the duodenum are objects of suspicion. Even in these severe cases recovery has followed a timely operation. Dr. Moynihan personally reports eleven such cases with but four deaths.

The pathology of duodenal ulcers receives much attention, and in the Appendix there is given a summary of all the cases operated upon by Dr. Moynihan and his associate, Dr. Collinson. For the nine years ending in 1908, 186 cases occurred—males 137, females 49. Eight patients were operated upon twice. The results are truly extraordinary, for up to the end of 1909, the mortality of the whole series was 1.6 per cent., and among the last 121 cases there was no death.

Altogether this volume is one of the most satisfactory to the student, the clinician, or the operating surgeon that has appeared for years, and one which in the future is bound to be the basis for many independent lines of investigation.

HENRY P. DE FOREST, M.D.

THE SURGERY AND PATHOLOGY OF THE THYROID AND PARATHYROID GLANDS. By ALBERT OCHSNER and RALPH L. THOMPSON, St. Louis, C V. Mosby Co., 1910. Octavo, pages 391.

In this book the large clinical experience of the senior author and the special attainments in pathology of the junior author have been combined to present in the most full and satisfactory manner the present knowledge and teachings with reference to the diseases of the thyroid gland. To this has been added the main facts which have been ascertained with regard to the parathyroid glandules.

The book is very freely illustrated, its style is clear, its teachings are plain, and its pages cannot fail to reward either the student or the experienced surgeon who desires to measure his own observations by the standard of others.

The operation of thyroidectomy is minutely described and most elaborately illustrated. This chapter may be considered as presenting in a most satisfactory manner all the elements of the modern methods of removing the diseased thyroid which have been elaborated of late years.

The authors in this book present to us what they consider to be the best, and give their reasons why it is the best. A very considerable part of the book, two-fifths of it, is devoted to the consideration of the parathyroid glandules, the surgical impor-

tance of which, in connection with the results following the removal of the thyroids, has so recently become demonstrated. Present knowledge of these little bodies and all their relations is fully set forth by the authors and adds very materially to the value of the volume as a whole.

THE PRACTICE OF SURGERY. By WALTER SPENCER, M.S., M.B. (London), F.R.C.S. (England), Surgeon and Lecturer Westminster Hospital, and GEORGE E. GASK, F.R.C.S. (England), Assistant Surgeon St. Bartholomew's Hospital. Philadelphia: P. Blakiston's Son & Co., 1910.

The preface heralds the fact that this book is in its tenth edition, a feature in itself to command attention because it attests to the popularity of this "Practice of Surgery" originated by the late W. J. Walsham, of St. Bartholomew's Hospital.

The editors, Messrs. Spencer and Gask, refer to the many courtesies of the collaborators whose contributions have kept this work abreast of the times by the revision and introduction of much that is materially new. Thus a chapter on blood examination, a revision of the section on Ophthalmic and Aural Surgery and many fresh skiagrams are recorded. Likewise emphasized are the additions in orthopædic surgery, the illustrations of museum and histologic specimens, and the drawings bearing on cystoscopy. The chapter on urethritis has been rewritten by Powell.

This book, certainly rejuvenated by these accessions, is in a fair position to gain many adherents among American students of surgery.

Its commendable features are the presence in one volume of general and regional surgery and the most important afflictions of the specialties. The work reflects the teaching of up-to-date surgery and mirrors the practice of the English school.

MARTIN W. WARE.

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ORIGINAL MEMOIRS.

ATONY OF THE BLADDER WITHOUT OBSTRUCTION OR SIGNS OF ORGANIC NERVOUS DISEASES.*

BY J. W. THOMSON WALKER, M.B., F.R.C.S.,

OF LONDON,

Assistant Surgeon to St. Peter's Hospital

repeated infection by means of the catheter. All these clinical types are familiar. I mention these two preliminary groups so that I may pass, with less fear of being misunderstood, to a third class of cases, which I now propose to discuss.

Such cases have atony of the bladder, but no obstruction to the outflow, and no signs of organic nervous disease can be discovered. Let me first relate a series of cases and then discuss them.

CASE I.—J. M. (VI 575), a well-built man of twenty-eight years, a salesman, came under my care at St. Peter's Hospital in July, 1909, complaining of difficult micturition and nocturnal dribbling. He first noticed difficulty in micturition five or six years before I saw him. The onset was insidious, and the trouble gradually increased. Twelve months ago, he had large steel instruments ($1^3/_{16}$) passed on several occasions at a general hospital, but without benefit.

For the last six weeks his water had dribbled away at night. He usually got up twice to pass it, but if he did not wake, his bed was soaked. He denied syphilis, but stated that he had an attack of gonorrhœa seven years ago.

When I examined him there was difficulty in starting micturition, and he frequently waited three or four minutes. The stream was slow and there was a good deal of after-dribbling. Large metal sounds ($1^4/_{16}$) passed into the bladder without any difficulty. There was residual urine varying in amount from four to six ounces.

On cystoscopy, the whole bladder showed a very pronounced degree of trabeculation (Fig. 2). There was a thick interureteric bar. The ureteric orifices were normal. The mucous membrane was clear, the blood-vessels somewhat dilated, especially at the base. The urethral orifice showed no abnormality. I could find no evidence of nervous disease, and referred him to Dr. Purves Stewart, who reported that "his pupils, cranial nerves, sensory, motor, and reflex functions were all normal."

CASE II.—G. W. B. (VII, 526), a wood machinist, aged thirty-seven, was brought to me by Dr. Robert Purdie. Fourteen years ago he began to have difficulty in passing water, and this had gradually increased. During the past four months there had been

pain. On one occasion he had passed some blood in the urine after a long bicycle ride.

He had lost flesh and strength during the last 18 months. He denied venereal disease. A year before I saw him, an instrument had been passed at two different hospitals under the impression that there was a stricture.

On examination the prostate was small and elastic, and nothing abnormal was detected by rectum. A large instrument was passed into the bladder without a hitch. There were 20 ounces of residual urine on one occasion and 22 on another. There was a moderate degree of trabeculation of the bladder and a small diverticulum was seen high up on the right wall. The prostate was not enlarged *per rectum* or intravesically. Dr. Purves Stewart reported, "I cannot find any evidence of organic disease in his nervous system."

CASE IV.—H. S. (VI, 59), aged thirty-four, complained of frequent micturition and soaking the bed at night. He gave the following history: He contracted syphilis in 1895, and was treated for two years. He first noticed difficulty in micturition and increased frequency in 1898. The frequency amounted to six or eight times during the day and not at all at night, and this increased during these years to half-hourly frequency during the day and once at night. There was a difficulty in starting, and the patient had to wait some minutes before the flow commenced. He was admitted to St. Peter's Hospital in 1901 with these symptoms. The stream was intermittent and there was after-dribbling. Occasionally he had to go to stool to get the water to pass. No stricture was found, there was no residual urine, and the bladder, examined by the cystoscope, was healthy. "The cut off muscle was divided" by the surgeon in charge of the case and the patient was said to be relieved.

When I saw him in 1910, he still complained of difficulty in starting micturition and straining during the act. The flow was intermittent. It commenced with fair force, but gradually fell away into a dribble. When the bladder was full and he lifted a heavy weight or coughed, a little urine escaped; there was a slight escape from the rectum also at any undue muscular exertion. He had passed urine every hour and a half to two hours and had soaked the bed at night for the past 12 months. The prostate was not enlarged by rectum. The urethra admitted the

I examined him in May, 1908. He complained of great difficulty in passing water. He had to wait some minutes before starting and strained during the act. So long as he kept straining with the abdominal muscles, the stream would flow, but whenever he ceased straining, the flow ceased.

At this time he passed water every two hours and not at all at night. The difficulty was increasing. From time to time he was unable to pass water at all, and he drew it off with a catheter. There was no obstruction to the passage of large instruments. The prostate was normal in size and consistence. There were ten ounces of residual urine. The bladder was trabeculated and the base rather puffy in appearance. No symptoms of nervous disease could be elicited.

CASE VII.—J. K. (VI, 129), a sweep, aged forty-six, came to me at St. Peter's Hospital in March, 1909, complaining of difficulty in micturition. He had noticed the difficulty for eight years, and it had gradually increased during that time. He also stated that he did not get an erection of the penis. When he attempted to pass water, he had to wait a minute or more before the flow commenced. The force was poor, the stream dropping down a foot in front of him. There was some after-dribbling. He passed water every hour during the day and three times at night. If he got excited, he felt an urgent desire to pass water, and had to pass it at once.

He had never had complete retention. The urine was clear, acid, and contained no albumin, mucus, or pus. The prostate was normal in size and consistence. There was no urethral obstruction. The bladder contained eight ounces of residual urine. It was slightly trabeculated, but otherwise healthy. No symptoms of nervous disease were elicited.

CASE VIII.—R. B. (VI, 364), aged thirty, came to my outpatient department at St. Peter's Hospital in January, 1909, complaining that his urine passed very slowly. I had examined him previously in August, 1907, when he stated that for 12 months he had experienced difficulty in starting micturition, and waited some seconds before the flow commenced. There was pain in the left groin on micturition. The urine was clear, there was no stricture and the prostate was normal.

In May, 1908, I again noted "difficult micturition, no stricture."

In January, 1909, he stated that the difficulty had increased.

and the vesical surface with the cystoscope. No abnormality was detected by these methods. Second, no signs of organic nervous disease could be elicited. In four of the cases I had the advantage of an opinion from Dr. Purves Stewart. In sifting the cases I have been particularly careful to exclude cases of early and irregular forms of disease of the spinal cord.

I shall now examine the characteristics of these nine cases. With two exceptions the symptoms commenced below the age of 40 years, and most were under 30 years (22, 23, 37, 22, 57½, 28, 38, 30, 59). There was a history of syphilis in two cases and of gonorrhœa in four others. The remaining three patients denied venereal disease. The common feature in all the cases was the gradual onset and increase of difficulty in micturition. The flow did not start promptly, there being a pause of some seconds or even minutes before the urine began to pass. The stream was feeble. It might commence with fair force, and then fall away into a dribble, or it might dribble at the start and gradually increase in strength and then relapse again into a dribble. It usually dropped a foot or so away from the patient. The stream was often intermittent—sometimes it was only projected at all by forced efforts of the abdominal muscles with a fixed diaphragm. At each respiration the flow ceased and recommenced as the diaphragm was again fixed and the compression renewed. The voluntary effort might be insufficient to start the stream at once, and in one instance the patient had to wait a quarter of an hour before the flow became re-established. At the end of micturition the stream again fell away into a dribble. In only one case had there been acute retention, and this recurred from time to time, and required the passage of a catheter.

Chronic distention of the bladder was present in four cases, the bladder reaching up to and above the umbilicus. In these cases the power of voluntary micturition remained, although greatly impaired. In the remaining cases residual urine was present and varied in amount from four to ten ounces. In one case there was an escape of urine on coughing and on any muscular effort. In this case, and in another, there was noc-

turnal dribbling from an over-distended bladder. In two cases the frequency of micturition was diminished. These patients informed me that they had no desire to pass water at any time. They might pass water once or twice in twenty-four hours, and if they did so oftener it was from a sense of fitness, not from any sensation of distention or of necessity. There were three patients who passed water more frequently than normal, as often as every hour during the day and several times at night. In two of these cases there was no question of the increased frequency being due to cystitis or other inflammation, for the increase had commenced spontaneously, before the passage of any instrument, and the urine was absolutely clear. In two of these cases there was no trace of inflammation in the bladder; in the third, the bladder base was somewhat puffy, and in this case there were a few filaments in clear urine. Any inflammation that might have been present in this case was insufficient to explain the frequency of micturition.

On cystoscopy there was in all these cases well-marked trabeculation of the bladder wall. This was usually general; sometimes one side was more trabeculated than the other, usually the trabeculation was less marked in the region of the apex than elsewhere. In three cases the trabeculation was extreme. In two less pronounced cases a solitary small diverticulum was present.

There was occasionally dilatation of the veins at the base of the bladder. The mucous membrane was clear and healthy in all except one case, where it was slightly puffy at the base. The ureteric orifices were normal. In one case the interureteric bar was thickened.

I shall now turn to discuss some points in regard to these cases.

1. What was the condition of the muscular apparatus of the bladder?

In dealing with the symptomatology, I have noted that the power of expelling the urine was diminished to a varying extent. This reduction of the effective power of the detrusor

muscle was measured by the manner in which the act of micturition was performed, and by the quantity of residual urine. The loss of power of the detrusor muscle usually commenced insidiously and was progressive; occasionally the onset was almost sudden and some amount of the power was regained. In one case the atony suddenly increased after being moderate for 14 years, so that the bladder became distended to above the level of the umbilicus. In another case there was a greatly distended bladder after 12 months, and in another after 18 months.

The condition of the muscular wall as shown by the cystoscope was very striking in all these cases. In all of them there was marked trabeculation, and in two the trabeculation was far in excess of anything that I have seen in other diseases of the bladder, of whatever nature. Where the trabeculation was moderate in degree it affected the lateral walls low down near the trigone, and to a less degree, the apex of the bladder. One side of the bladder might show trabeculation while the other was smooth. In some of the cases a tense, sharp band of muscle passed across a portion of the bladder wall and the wall above or below this was deeply hollowed. Where the trabeculation was present in a marked degree, it was universal, all parts of the bladder being affected, except the trigone, which remained unaltered. The larger muscle-bundles were sharply defined and widely separated. They stood out like round cords and branched into smaller strands, which disappeared in the general network. Between these larger bundles there were saucer-shaped depressions of varying depth, the walls of which showed fine secondary interlacing muscle-bundles.

The degree of trabeculation did not correspond to the amount of residual urine, nor to the duration of the symptoms. One patient with 20 ounces of residual urine, and symptoms which had lasted for 14 years, had a considerable degree of trabeculation most marked on the right side; another patient with an equal quantity of residual urine and symptoms for four years showed only slight trabeculation, while a third with four ounces of residual urine and symptoms for five or six years had universal trabeculation of an extreme degree.

Trabeculation has hitherto been regarded as a sign of hypertrophy of the bladder, and its presence has been looked upon as proof that obstruction to the outflow of urine was present. I have long suspected that there must be other factors in the causation of trabeculation of the bladder, which might act with obstruction or apart from it. In the first place I have frequently observed trabeculation of the bladder where obstruction to the outflow was certainly absent, where there was no difficulty in micturition, and where there was no obstruction to the introduction of full-sized instruments through the urethra. I should be departing too far from the object of this article were I to bring forward more than one case in support of this statement.

Let the following example suffice:

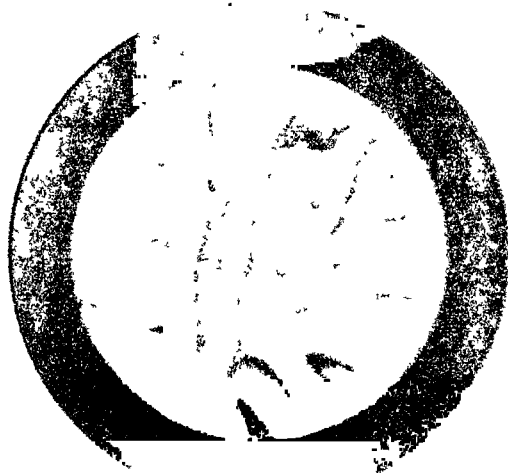
I saw F. M., a barrister, aged forty-six, in consultation with Dr. F. E. Batten. He gave the following history:

In May, 1909, he had an attack of hæmaturia following a game of golf, and there was some pain in the left side of the abdomen. The urine cleared and on examination contained hyaline and finely granular casts, a few red blood-corpuscles, renal cells, and calcium oxalate crystals. In November, 1909, he had an attack of renal colic on the left side, which lasted twelve hours. A radiogram showed a small calculus in the pelvic segment of the left ureter. He had no increased frequency until he was put on diuretics and large quantities of barley water, when he passed a good quantity of water every two hours, and rose once at night. There was no difficulty, pain, or discomfort on micturition. The prostate was normal in size and consistence, and there was no obstruction to the passage of large instruments. There was no residual urine. On cystoscopy the ureteric orifices were normal, and the mucous membrane of the bladder healthy. There was very marked trabeculation of the bladder, which was well distributed over the bladder. It was most marked at the base and at each lateral wall and not so marked at the apex. Dr. Batten assured me that there were no signs of organic disease of the nervous system. The trabeculation in this case was not due to hypertrophy produced by obstruction.

Nitze was the first to observe trabeculation of the bladder with the cystoscope in the early stages of *tabes dorsalis*, while Orth and others have described the condition *post mortem* in old-standing cases of *tabes*.

In an article on this subject Bohme¹ has described eight cases of *tabes dorsalis* in the early stage in which trabeculation of the bladder was present, and he looks upon this condition of the bladder as a diagnostic sign of *tabes* in the earliest stage. My own experience of the bladder in *tabes* is confined to 31 cases, nearly all of which were of the peculiar type in which the bladder is early affected whilst the other nervous symptoms are insignificant, and they usually came to me without any knowledge of their nervous disease. These cases correspond to those on which Bohme writes. In these cases some degree of trabeculation was usually present. It was, however, not infrequently absent, and in none of the cases was the degree of trabeculation so extreme as in two of the cases I have just described.

There is, therefore, I submit, a considerable body of evidence to show that trabeculation of the bladder may be observed in a pronounced degree quite apart from any of the gross forms of urethral obstruction with which we are familiar. There is a difference between this form of trabeculation and that which is observed in obstructive diseases. The trabeculation of an obstructed bladder is coarse, the muscular ridges thick and irregularly branching, and the interspaces deeply pouched; the openings of the saccules are often narrow (Fig. 1). In the trabeculated bladder without gross obstruction, the muscle ridges are fine and evenly set and the branchings regular and orderly (Fig. 2). Very fine twigs can frequently be seen branching and interlacing. The interspaces are not so deep and in my cases were usually saucer-shaped. The distribution of the trabeculation is also different. In the obstructed bladder the trigone is broken up into hypertrophied ridges. The ureteric bar is hidden among a number of thick trabeculæ, and it is often difficult to find the ureteric orifices. The rest of the bladder is also affected. In the unobstructed



1. The first of the four points is the most important.



2. The second of the four points is the most important.

trabeculated bladder, as Bohme has pointed out, the side walls and the apex of the bladder are affected, while the trigone escapes.

In the cases that I have just described the trabeculation was sometimes localized or more marked on one side than on the other. The area usually affected in such cases lay outside and behind the ureteric orifices and there might be a solitary area of trabeculation here while the rest of the bladder surface was unchanged. A solitary muscle band sometimes stood up strongly for a considerable distance. Such fine distinctions, while they do not invariably hold good, may certainly be recognized in the majority of cases.

Bohme adopts a theory which V. Frankl-Hochwart² advanced to explain difficult micturition and retention in disease of the spinal cord, namely, that the sphincter is unable to relax, and he looks upon the trabeculation in cases of tabes as due to this cause acting as an obstruction. According to this author, therefore, these tabetic bladders are to be ranged along with that of enlarged prostate and of stricture. I do not feel satisfied with this explanation. In one of my cases the bladder sphincter shared in the atony of the detrusor, for there was an escape of urine on coughing or on any muscular exertion, and in this case, with only seven ounces of residual urine, and another case, with from four to six ounces of residual urine, there was unconscious dribbling at night. Obstruction by the sphincter could, therefore, be excluded in these cases. The trabeculated bladder, which is not secondary to any of the tangible forms of obstruction, such as enlarged prostate or stricture, may be explained in another manner, if we can rid ourselves of the belief that trabeculation necessarily means hypertrophy. I would venture to suggest that the earliest change in these cases is atrophy, and that the prominence of some muscle-bundles is largely due to atrophy of the neighboring bundles. The greater calls that are made on the surviving bundles may be supposed to call forth a compensatory hypertrophy, but this is insufficient to do more than partly replace those that have atrophied. This suggestion fits in well

with the condition observed in cases of diseases of the spinal cord, for it is one of the characteristics of these cases that a considerable amount of improvement may take place in the muscular power of the bladder after the first few months or year of the atony.

2. What was the condition of the sensory apparatus of the bladder?

The sensibility of the bladder in these cases varied. In two cases it was certainly blunted, if not abolished. The patients felt neither the sharp sensation of the contact of urine with the mucous membrane of the prostatic urethra, nor the feeling of tension and weight above the pubes and in the perineum or penis that is experienced by normal individuals. These patients would go through the whole day without passing water and without discomfort. On the other hand, there were three cases where frequent micturition and urgency were prominent symptoms. In these cases the urine did not show evidence of cystitis, and the cystoscope displayed no inflammation. The mucous membrane of the bladder was undoubtedly hypersensitive in these patients. In the remaining cases there did not appear to be either diminution or increase in the sensibility of the bladder.

Every cystoscopist is familiar with the difficulty which a patient experiences in commencing micturition after the prostatic urethra and bladder-base have been rendered anæsthetic by means of cocaine instillation. The inability to pass water lasts a quarter or half an hour and then passes off as the effect of the drug disappears. While the prostatic urethra and bladder-base are still anæsthetic, it is often possible by a voluntary effort to start micturition, and, once started, the flow is sustained, with a force as great as in a normal individual. If micturition cannot be initiated and a catheter is passed, the fluid flows with as much force as where no anæsthetic has been applied. When urine has been passed voluntarily from a cocainized bladder, there is no residual urine left if none was present before the application of the anæsthetic. It therefore appears that anæsthesia of the bladder or of the prostatic

urethra, if judged by this standard, can only prevent the initiation of micturition, but does not affect the contraction of the bladder muscle once it is started.

Dr. Parkes Weber³ has recorded an interesting case of paralysis of the bladder in a man aged 57 years. The patient was not aware whether his bladder was full or empty. Dr. Weber suggested that "a local hypo-anæsthesia (occurring as an early symptom of nervous disease) was an important factor in this retention of urine and vesical dilatation." This theory is inapplicable to the cases I have recorded, for the following reason: anæsthesia of the bladder, as I have pointed out, may prevent micturition by preventing its initiation, but once micturition is started, the stream is full and strong, and no urine is left behind as the result of the anæsthesia.

In my cases the stream was not merely delayed, as in cases of anæsthesia, but it was also feeble. Whether passed through the urethra or through a catheter, the want of force was obvious. Moreover, there was a quantity of residual urine in all the cases. If anæsthesia were the cause of the vesical inefficiency, there should have been an absence of initiation of the act and therefore complete retention and inability to micturate in all the patients, but this was not the case. And further, as I have shown, there was hyperæsthesia of the bladder in three cases.

3. The relation of these cases to vesical atony, secondary to obstruction.

Atony of the bladder, partial or complete, is most familiar to the surgeon as a result of gross enlargement of the prostate. It occurs also as a result of stricture of the urethra. Such lesions are readily demonstrated.

There is a class of cases that require more careful consideration, for they are more difficult to diagnose and exclude. I refer to cases where there is slight enlargement of the prostate, or atrophy of the prostate, or fibrous conditions at the internal meatus.

It is well known that enlargement of the prostate may produce sufficient obstruction to cause chronic retention of urine without any enlargement being detected on rectal exam-

ination. Such cases are not common, but they are of sufficiently frequent occurrence to receive general recognition. In these cases there is either a small pea- or cherry-like intravesical projection of the prostate or a prominent rim, at the back and sides of the internal urethral orifice, that has been aptly called a "collar-like" projection of the prostate. Such changes are recognizable by means of the cystoscope. They are evident when the bladder is opened above the pubes, and the orifice is inspected or palpated.

Another form of obstruction that cannot be recognized by rectal palpation is "contracture of the neck of the bladder." In this condition there is a fibrous thickening of the tissues around the internal meatus. It appears to result from old-standing inflammation, usually of venereal origin. There is obstruction at the entrance of the bladder to the passage of instruments. Stenosis of the orifice can also be detected by the finger introduced through a suprapubic cystotomy wound. With contracture of the neck of the bladder or apart from it, there may be atrophy of the prostate, which results from a similar cause. Atrophy of the prostate is easily recognized by the finger from the rectum.

Any of these conditions may cause obstruction to the outflow of urine, and they must therefore be carefully excluded by rectal palpation, by the passage of sounds, by cystoscopy, and if necessary, by suprapubic cystotomy.

In sifting my cases I have rigidly excluded all cases where abnormality of the prostate or prostatic urethra or vesical orifice of the urethra could be detected by any of these methods. The following case came under my care before I realized that there might be atony without obstruction or signs of nervous disease.

CASE X.—G. H. (1906, II, 246), a healthy man of sixty-three years, was admitted to St. Peter's Hospital with chronic retention and overflow.

Four years ago his urine began to dribble and his bladder was found to be distended. His doctor passed a catheter.

For three years he passed a catheter twice daily, and then

was advised to cease using the instrument with the result that he had pain and difficulty in micturition. The urine has been foul and there has been hæmaturia. When I examined him, he passed urine every two hours and rose once at night. There was urgency to pass urine, but he had to wait five minutes or more before the flow commenced. There was pain at the meatus before micturition, and scalding during and after the act. The stream was poor in force and small in volume, and sometimes stopped in the middle of the act. There were clots of blood in the urine. He had had an attack of gonorrhœa at the age of twenty years. No symptoms of organic disease of the nervous system could be elicited. The prostate was normal in size and consistence. There was a quantity of residual urine, which contained blood and mucus. On cystoscopy there was cystitis and the bladder was trabeculated and there were sacculi. The prostate was not prominent in the bladder.

On August 1, 1906, the bladder was opened above the pubes and the prostate was examined. The prostate did not project into the bladder, and was small bimanually. Under the impression that I might have to deal with a case of contracture of the neck of the bladder, I forcibly dilated the prostatic urethra with my finger. Dr. Young of Baltimore was present at this operation, and suggested that a perineal prostatectomy should be done.

On August 30 the patient had recovered, but was entirely dependent on his catheter, passing no urine voluntarily. The urine was clear and without deposit.

On September 5 I performed perineal prostatectomy, dissecting away both lobes of the prostate. The patient was discharged on October 6 healed, and with clear urine, but absolutely dependent on his catheter.

From this case I learned that atony of the bladder might exist without signs of nervous disease, and be unrelieved by operation undertaken with a view to remove any possible obstruction.

4. The relation of these cases to tabes and other forms of disease of the spinal cord.

I have already referred to cases of early and irregular tabes as a cause of atony of the bladder and I do not intend to discuss these cases at present in detail. It is necessary, however,

to consider whether the cases I have described do not at a later period develop symptoms of tabes or other disease of the cord. None of these cases developed symptoms of disease of the spinal cord while they were under my observation. One might, I think, reasonably expect some symptoms of organic disease to develop in, say, three or four years after the bladder condition had become established. The following was the duration of the symptoms in these cases on the first occasion on which I examined them, and some of the patients have remained under my observation since: (1) five or six years, (2) fourteen years, (3) four years, (4) twelve years, (5) four months, (6) five years, (7) eight years, (8) two and one-half years, (9) three months.

I think there is here sufficient evidence to prove that these cases do not belong to the early and irregular forms of spinal disease.

Etiology and Nature of these Cases.—There is little information to be obtained from these cases in regard to etiology. So far as I could ascertain, only two patients had suffered from syphilis. One patient had had lead poisoning.

The reflex centre for the contraction of the bladder and the inhibition of the sphincter is placed, according to general belief, in the lumbosacral cord at the level of the third and fourth sacral segments. In diseases of the spinal cord, such as tabes, this centre is supposed to be affected, and atony of the bladder results as one of the symptoms of this disease. It is more difficult to explain the occurrence of disease confined to this centre affecting no other part of the cord.

Clinical and experimental researches by Goltz, Freusberg⁴ and Ewald,⁵ and C. R. Müller⁶ have shown that the lowest reflex centres, which control the functions of the bladder and rectum and the erection of the penis, are situated in the hypogastric and hemorrhoidal plexuses of the sympathetic. The cases that I have recorded are, I believe, to be explained by the existence of some lesion of this sympathetic reflex centre. This would explain the absence of symptoms of disease of the spinal cord which is a feature in these cases.

It is interesting to follow these cases into their later stages, and to note how secondary complications supervene and eventually conceal the original nature of the case. Without exhausting the resources of my clinic at St. Peter's Hospital, I have selected the following cases as representing the later stages of the disease.

CASE XI.—W. J. J., a journalist, aged fifty-three, was sent to me by Dr. J. M. H. MacLeod, complaining of thick urine. Eighteen years before I saw him, when thirty-five years of age, without apparent cause and without warning he suddenly lost the power of passing water. Since that time he had never passed urine voluntarily. All his urine was drawn off by catheter, which he passed himself without difficulty. His bladder became infected, and the cystitis varied in severity from time to time. He admitted one attack of gonorrhœa, but denied syphilis. When I examined him he was passing his catheter every two hours during the day and twice at night. The urine was foul and thick with shreds and mucopus. There was no obstruction to the passage of instruments through the urethra. The prostate was small but not atrophied. There were no signs of organic disease of the nervous system.

CASE XII.—W. E., a coachmaker, aged forty-three, complained of inability to pass water. The onset was gradual two years ago when there was difficulty in passing water. This increased until he could pass no water voluntarily, and was entirely dependent upon his catheter. He drew off the urine from four to six times during the day and four or five times at night. A small stone formed in a pouch in the bladder and was crushed and removed. The urine was thick, alkaline and stinking. There was no obstruction to the passage of instruments and the prostate was normal. The bladder was trabeculated and showed numerous sacculi. There were no signs of organic nervous disease.

In the twelve cases here described, we have to deal with atony of varying degree. The urethra shows no sign of obstruction, and the prostate is healthy; there are no signs of organic disease of the nervous system. In a number of the cases the atony has been present for a sufficient period of time

to be certain that tabes or other disease of the spinal cord will not develop. There are acute and chronic cases. Such cases, I submit, form a class by themselves.

Literature.—There is little in the literature that bears directly on these cases. A few cases have been published, which appear to me to be similar in nature. Albarran and Noguès⁷ have recorded two cases of retention of urine in young men, which they were unable to explain and could not classify. Mr. S. G. Shattock⁸ described a post-mortem specimen of dilated bladder and ureters, and suggested that that condition was of “infantile origin” and analogous to idiopathic dilatation of the colon. The case may possibly belong to this group. I have already referred to a case recorded by Dr. Parkes Weber which he regarded as one of early nervous disease. It is possible that this case was similar to those described. Professor Casper⁹ has recorded two cases of chronic retention of urine, one of which had signs of nervous disease and the other had none. The latter case appears to me to be similar to those I have described.

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CERTAIN CONGENITAL STRICTURES OF THE URETER.

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A CASE of congenital stricture of the ureter which came under our observation at the Carney Hospital led us to examine medical literature for pertinent information. To our surprise we found that the text-books of surgery either dismissed the subject with few words or said nothing at all of it. We could find but scant information (chiefly scattered reports of one or two cases) in English and American medical literature. A search of the German and the French, however, disclosed reports of several series of collected cases as well as interesting discussions of the general subject. Such information as we have been able to cull from these sources and from a study of additional cases will be set down in this paper. The subject in its entirety goes far beyond the limits of a single communication, and only that phase of it exemplified by our own case will be treated herein.

Ureteral stricture may be congenital or acquired. Of the latter, which is the less frequent, we shall have nothing to say. We shall have to do only with congenital stricture and shall regard the word "stricture" in its wide sense, including in the term any narrowing of the ureter even up to complete impermeability, sharply localized narrowings as well as those which may include the whole or any part of the structure. In other words, we shall treat of congenital atresia (narrowing) of the ureter, partial, complete, or even accompanied by aplasia (imperfect development).

EMBRYOLOGY.

A grasp of the essential features of the embryonic development of the genito-urinary apparatus will enable us to understand better the possibilities arising from congenital faults,

and will determine more clearly the limits within which we propose to hold this discussion.

In early embryonic life the genito-urinary and the intestinal tracts have a common termination in the cloaca. The first rudiment of the permanent renal system (the ureter and the kidney) arises at the beginning of the second month of fetal life as an outgrowth with a narrow lumen from the dorsal side of the Wölffian duct, close to the termination of the latter in the cloaca. This outgrowth, the renal bud, the stalk of which represents the adult ureter, develops in a general upward direction and soon shows at its blind (upper) extremity a bifurcation, the forerunner of the adult renal pelvis; the two divisions of the bifurcation represent the chief renal calyces in the adult. The mesodermal tissue surrounding the bifurcation and its branches contributes to the formation of the adult renal parenchyma. In time the cloaca shows a tendency to differentiation, becomes smaller, and the common opening of the ureter and Wölffian duct is now in the bladder, to the formation of which the cloaca and allantois have contributed. In the further course of development the ureter and Wölffian duct begin to separate (from above downward), and the segment common to both finally disappears, the ureter and duct acquiring separate openings; these are at first close to each other, but subsequently, because of the enlargement downward of the space between them to form the prostatic urethra, they are far apart, the ureter terminating in the trigone of the bladder and the Wölffian duct (the future vas deferens, etc., of the adult) in the prostatic urethra as the ejaculatory duct. In the meantime, the cloaca as such has vanished and the hind-gut has separated entirely from the anterior division. In the female the Wölffian duct practically disappears entirely; usually only an unimportant remnant remains in the broad ligament. Occasionally, however, it persists as a completely or partially open duct (Gärtner's duct) passing down in the superficial tissue of the cervix and vagina and terminating in the vulvar cleft at the outer side of the vaginal opening near the duct of Bartholin.¹ This is, of course, but a mere outline

of the story. To those interested in the detail of the embryologic development of the genito-urinary tract and in anomalies resulting from congenital defects and vagaries therein, Huntington's² Harvey lecture (upon which I have drawn for much of this paragraph) will be most attractive.

It is chiefly important for us to carry along three facts bearing on this phase of the subject, viz.: (1) the early common cloacal termination of the rudimentary genito-urinary and intestinal tracts and their subsequent complete separation; (2) the primary origin of the ureter from the Wölffian duct, which in the male represents the future vas deferens, ejaculatory duct, etc.; and (3) the early common opening of the ureter and Wölffian duct in the embryonic bladder and their later acquisition of separate openings, at first close together but finally far apart. Now with these facts in mind it is clear that an arrest or a failure or an imperfection of development may have to do with an ureter opening or evidently intended to open, (1) into the intestinal tract, or (2) into the genital tract, or (3) into (*a*) the bladder or (*b*), as a rare occurrence, elsewhere usually in connection with some persistent remains of the Wölffian duct. With the first two of these divisions the paper will not deal. It will be limited to a discussion of congenital strictures of such ureters as may be included under class *a* of the third division. Cases falling under class *b* have been reported by Förster,³ Secheyron,³ Vrolik,³ Ortmann,³ and Tangl.⁴ Though they form an interesting series, no further consideration will be given them here, and only such congenitally strictured ureters as open, or were evidently intended to open, into the urinary bladder will be brought into question. Much that will be said of them would be equally true of such ureters opening into the intestinal or into the genito-urinary tract, but these divisions have sufficient matter peculiar to themselves to merit separate consideration.

ANALYSIS OF CASES REPORTED.

In 1896 Schwarz,⁵ in the course of a long general article, reported 22 cases which come within the limits of this paper. To these Welz⁶ added six cases in his Inaugural Address in

1903. Twenty-eight additional cases * (making a total of 56) will appear in this paper, 22 of them representing scattered, hitherto uncollected reports from medical literature. Six cases are reported here for the first time, one through the courtesy of Dr. E. H. Nichols of the Boston City Hospital, another (Case I) by the kind permission of Dr. E. Channing Stowell of the Massachusetts Infant Asylum, three others by courtesy of the Drs. Mayo, Rochester, Minn., and the sixth, a personal case from the surgical service of the Carney Hospital.

Of these 56 cases, 25 occurred in males, 16 in females, while in 15 cases (including monstrosities and pathologic specimens) no mention of sex was made. One would expect, however, that it would have no particular influence here.

A study of the ages shows that in some cases the defect is immediately incompatible with life, that in others it quickly develops to that stage of incompatibility, that in still others it remains latent in its effects till in some way infection starts up, and that in many it exists unsuspected during life and is found only at autopsy after death from other causes. To avoid tiresome figures, it may be said that a very striking feature is the number of cases discovered in subjects under five years of age and in those over sixty; in other words, at the extremes of life.

Forty-five cases had to do with single and 11 with supernumerary ureters. The left ureter was affected in 27 instances, the right in 17, both ureters in 10, and two reports fail to mention the side affected. Of the 11 supernumerary ureters, 6 were on the left side and 5 on the right; in 6 the upper ureter and in 3 the lower was affected. In 2 cases the supernumerary ureters merged into a common trunk near the bladder. All this is not entirely in agreement with Veau,⁷ who speaks of the frequency of the congenital defect in connection with supernumerary ureters and asserts that the upper ureter is almost always affected.

* Since I had received the proof of this paper for correction, Dr. E. A. Codman, of Boston, called my attention to two cases which he had reported and which I had overlooked. These appeared in the Boston Medical and Surgical Journal of May 28, 1908, and of August 5, 1909.

ETIOLOGY.

The exact etiology of the defect is, of course, obscure. Men of equal repute sometimes hold diverse opinions as to the cause of certain features of the same case. It is generally agreed, however, that the malformation is the result of a primary defect, or of an arrest of an earlier embryonic stage, or of a secondary retrogressive metamorphosis. Mutach considered his case (Case XXVII) to be the result of an arrest of a fetal stage, contrary to the opinion of Virchow, who looked on it as the result of a past inflammatory process. Weigert believed that the cystic kidneys in his case (Case XXVI) were not the expression of a primary defect, nor of an arrest of development, but of an entirely secondary process. This seems reasonable, inasmuch as the upper portion of the ureter and the renal pelvis develop from and after the lower ureter, and in such a case as Weigert's the lower part of the ureter must have existed once and have been destroyed. Still, whatever the etiologic factors may be, our interest in them is only academic; for over them as causes we can have no control, and it is through their effects alone that they appear and appeal to us.

LOCATION AND RESULTS.

Now these effects are concerned with two factors, (*a*) the location and the form of the stricture, and (*b*) its after results.

The Location.—In several instances (Cases XXVI, XXXI, *v.g.*) a portion of the ureter was wholly fibrous, while in others (Cases XXVIII, XXXIII, XLIII, L, LI, *v.g.*) the ureter was impermeable throughout and was represented only by a fibrous cord—a functionless ureter. Teyssèdre⁸ collected reports of 11 such cases. The further development of this defect leads to absence of the kidney and of the whole or a portion of the ureter. Teyssèdre reported 74 observations of this condition. In 8 cases of our series the stricture was located in the upper third of the ureter, usually at or close to

the opening into the renal pelvis. In 36 instances the obstruction was in or very close to the bladder. Nichols's case showed stricture both at the upper and at the lower end of the same ureter, and Allen and Parker's at the lower end of one ureter and at the upper end of the other. The same ureter may present alternating portions with and without a lumen (Case XXVII). However, leaving the great rarities aside, it is fair to assume that the ureter, if present, in the great majority of cases reaches the bladder and that the stricture is usually in or very close to that organ.

The Form.—This varies very much. It may be represented by a sharply defined narrowing (Cases XL, LIII), or may take the form of a section with a length varying from one-fourth inch to four inches of the calibre of a fine probe. The stricture may be passable or impassable.

The most important, and, in their effects, the most far-reaching modifications of form are seen in the obstructions at the lower end of the ureter. In these the ureter usually reaches the bladder and in most instances ends there in a blind sac. This blind end may be just beneath the mucous lining of the bladder, may lie in the muscular layer of the bladder wall, or may just reach the outer wall. If the blind end is in the muscular layer and one examines the bladder from within, either there will be no trace whatever of an ureteral opening, or in its place will be seen a dimple, a shallow invagination of the mucous membrane. If the blind end is just at or in the outer layer of the bladder wall (and this is a rather unusual occurrence), there may appear just above it a localized dilatation of the ureter which takes the form of a cyst just behind, *i.e.*, outside, the bladder (Cases XIX, XXII, XXXII). It is conceivable that this external pocket, if large, may compress the bladder, crowding in the posterior wall, or may, in women, even bulge the vesicovaginal septum.⁹ In Case XIX, the cyst was as large as an egg. In some similar cases, this localized cyst-like formation does not take place, but the ureter becomes dilated throughout its length.

The most interesting forms, however, have to do with

the ureters ending just beneath the vesical mucous membrane. These produce a cyst-like protrusion of the mucous wall into the vesical cavity. The protrusions range in size from that of a small pea (Case V) to one completely filling the bladder (Cases XI and XIV); the smaller are usually hemispherical in shape; the larger are either triangular or finger-shaped, sometimes reach the vesical opening of the urethra, may pass varying distances along the course of the latter (Case XII), and in women may even appear at the external meatus (Cases VI, XIII, XVII). When empty, they are flat and flaccid; when full, are finger-like, pear-shaped, and tense, broader and thicker at the base, and gradually tapering and thinning in the direction of the tip. Occasionally one ends in a bulbous enlargement (Case VI). They exhibit lengths varying from 0.5 cm. (Case I) up to 6.5 cm. (Case IX). The diameter at the base varies from 2 cm. (Case XII) to 5 cm. (Case IX). They are lined on one side by the ureteral and on the other by the vesical mucous membrane. The ureteral opening into these pouches may be bristle-like or may be an aperture 2 cm. in diameter. In all Brinon's¹⁰ observations the protrusion connected with an ureteral dilatation. Such a condition would be expected; for usually (in 12 out of 17 cases in this series) the protrusions are blind cul-de-sacs without an opening into the vesical cavity. In 5 cases there was a communication between the protrusion and the vesical cavity, almost invariably by minute openings at the tip or on the side of the former. A supernumerary ureter gave rise to this form of ending in 8 cases, a single ureter in 9 cases. It is usually unilateral, but Burckhard reports an instance (Case II) in which it was bilateral. The contents of the protrusions is usually a clear fluid; it may vary considerably in color in shades of brown and yellow. Sometimes a muddy or cloudy fluid is seen (Cases VIII and I).

Effect on Ureter.—When the obstruction is at the lower end, the ureter is almost invariably dilated, thin-walled, and tortuous. It varies in size from that of a pencil to that of the small intestine. Various observers use descriptive terms which

range from "dilated" to "tremendously" and "enormously dilated." It becomes widened and lengthened. Occasionally it is lobulated, shows windings and twistings, kinks and folds, and has been described as having "the appearance of a string of sausages." In such cases the wall on section is found to be thin and to show valve-like folds, which in places narrow the lumen. This may represent a persistence of the fetal type of ureter; for Hamann¹¹ finds that spindle-shaped dilatations and tortuosities of the ureter are nearly constant in the foetus and therefore normal. Byron Robinson,⁴¹ too, notes that all mammals possess ureteral dilatations and constrictions, which are, in his opinion, heritages from the Wölffian body, enhanced by environment, as erect attitude. It is an anatomic fact that where an ureteral constriction exists from heritage or is a pathologic condition, an ureteral dilatation will exist proximal to it.

In but three cases (Cases II, IX and XVI) is the ureteral wall described as "thickened," though Förster asserts that the walls keep their normal thickness or grow thicker. This was certainly not true of our own case. Intercurrent inflammatory processes, however, might produce such a condition. Shield (Case XXXVIII) reports an unusual case in which an enormously dilated ureter filled the whole pelvis with its distended coils, which pressed on the rectum and on the other ureter. In but one instance (Case XXVIII) in this series was mention made of the fat layer about the ureter and pelvis to the frequency of which Veau called attention. When there is a double ureter, the two, though usually in the same fibrous envelope, ordinarily follow separate paths. Veau, however, has often seen the dilated abnormal ureter twine about the healthy ureter. Förster relates what is probably a unique case (Case XLVIII) in which a much-dilated right ureter opened into the bladder on the left side. The effect of obstruction at the upper end of the ureter is too well known to deserve description here.

Effects on the Pelvis and Kidney.—Here the effects are striking; for either an enormous hydronephrosis or a most

marked primary atrophy may result from ureteral obstructions of the same location and character. It is only fair to state that, judging from a study of the present series, hydronephrosis of varying degree is the rule. It may show itself simply as a slight or a moderate distention of the pelvis, or it may present as an enormous cyst filling the whole abdominal cavity, with only remnants of the true kidney tissue in the cyst wall (Case XVI). Between these extremes many intermediate grades are seen. Infection, direct or indirect, produces its usual disastrous effects, and in some cases completely disorganized kidneys are found. In kidneys with supernumerary ureters, that half of the organ from which the affected ureter runs usually shows characteristic hydronephrotic changes, while the rest of the organ is normal. The only exception occurs when both ureters unite to form a common trunk after leaving the kidney.

Several cases (Cases VIII, XI, XXXIX, XLV, *v.g.*) of this series showed a marked degree of renal atrophy, the kidney in one case (XXXIX) being of the size of a bean. Study of these cases shows no sufficient reason why atrophy should have ensued rather than hypertrophy. Undoubtedly, some of the cases were examples of secondary atrophy, but a microscopic examination would probably have proven some of them to have been primary. Lindemann¹² produced complete exclusion of the ureter by ligature in six dogs, and in three simple primary atrophy of the kidney followed, while in three others simple hydronephrosis was the result. He concluded from a careful experimental study of the subject, that whether a primary atrophy of the kidney or an hydronephrosis develops in animals after ligature of the ureter depends on the grade of development of the compensatory anastomosis through the vessels of the capsule. The intrapelvic pressure following the ligature blocks the renal vessels coming in at the hilus, and the further effect of the ligature depends on the amount of blood the kidney substance can get through anastomosis between the kidney substance and its capsule. Kidney atrophy means a primary insufficiency of compensation through the

blood supply of the capsule. On the contrary, if the capsular blood supply is free, hydronephrosis will follow, and the fluid will accumulate again and again after tapping. Sollman, Williams, and Briggs,¹³ in a series of experiments somewhat like Lindemann's, found hydronephrosis in every case (four dogs). Chemical examination of the fluid thus accumulating in the kidney showed it to be a transudate poor in proteids and chiefly noteworthy because of the absence of notable amounts of the specific urinary constituents. Complete ureteral obstruction, then, probably means rapid cessation of the true secretory function of the kidney; if a collection of fluid ensues, it is not urine but is a transudate (Case XI). Partial obstruction does not mean such cessation, and the resulting accumulation of fluid is an uronephrosis (Lindemann). Almost all cases of the present series showed what was practically a complete ureteral obstruction; the reports of such as showed partial obstruction contained no chemical study, and consequently no further information on this point can be drawn from them. In the light of our present knowledge it is very probable, however, that Burckhard's case (Case II) was one of uronephrosis rather than of hydronephrosis. The same is true of Drew's cases (XXXV, XXXVI). Lindemann's conclusion as to the occurrence of hydronephrosis and atrophy has been generally accepted.

Of course, in the above paragraph true primary atrophy of the kidney is meant in contradistinction to the atrophy secondary to hydronephrosis, which is a progressive pressure atrophy with flattening of the papillæ, obliteration of the uriniferous tubules and of the glomeruli which goes on till only a few remnants of kidney tissue remain flattened out in the wall of the cyst. Lindemann asserts that for true hydronephrosis persistence of the glomeruli is characteristic.

Several cases of the present series showed in place of the kidney only a conglomeration of cysts, several separate pockets. Whether they represent primary congenital defects or are the last stage of a secondary process is not apparent.

The kidney of the opposite side shows only hyperæmia and compensatory hypertrophy in the uncomplicated cases.

Effects on the Bladder.—The cystiform protrusions of the blind-ending ureter into the bladder may cause marked secondary pathologic changes in the bladder, in the other ureter, or in the other kidney. The protrusion from a supernumerary ureter may block the opening of the healthy ureter of the same side (Case I). The pocket may be so large as to block the ureteral opening of the other side. In other cases it may wholly obstruct the vesical opening of the urethra, give rise to a distended, hypertrophied bladder, and set going the usual sequelæ of retention of urine. Examples of all these possibilities are present in the appended abstract.

SYMPTOMS AND DIAGNOSIS.

In our series, 19 cases gave either subjective or objective symptoms, which may be attributed with fairness directly or indirectly to the congenital trouble. In 11 cases where one might expect symptoms, none were mentioned in the histories. This, of course, does not make first-class evidence; for most of the cases were reported more from the pathologic than from the clinical point of view. Many cases occurred in subjects too young to make complaints. On the other hand, Heller instances a case (Case XVI) of a seventy-nine year old woman who died of pneumonia, in whom autopsy disclosed an hydronephrosis practically filling the whole abdomen. Bostrom's case (Case XI) indicates that even a moderate protrusion into the bladder may exist for some years and be without symptoms. It is, of course, sufficiently evident that a strictured ureter on one side with a resulting renal atrophy or even with a moderate hydronephrosis might exist indefinitely without symptoms, if no intercurrent infection set in.

The symptoms, in such cases as gave any, varied much, and it is impossible to draw from them any picture that would definitely determine in future cases a diagnosis of congenital stricture. Some trouble with urination, usually frequency, is the most common complaint. Cases VII and LI, and one of

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Mayo's (see text) had temporary and recurrent hæmaturia. The reason for this in uncomplicated cases is difficult to understand. It is by no means a common symptom, and, when present, is usually not so to a marked degree. Yet in Mayo's case it continued for seven weeks at a stretch and was sufficiently profuse to produce pallor. Painful micturition and strangury were mentioned in one instance. Drew's cases (Cases XXXV and XXXVI), which may, perhaps, be regarded as typifying cases with obstruction high in the ureter, complained of increasing pain and discomfort in the loin and frequency of micturition; both cases exhibited tumors in the loin. Here diagnosis of hydronephrosis must have been relatively easy, but the congenital cause could not have been foretold. Pain in the loin with a sausage-shaped tumor rising from the pelvis was present in our case at the Carney Hospital. Cystiform protrusions into the bladder, when they are large, are apt to give very marked symptoms, both subjective and objective. Boström's two cases (Cases XI and XIV) serve best to indicate what may probably be regarded as typical examples. His first case (Case XI) was that of a child six months old, who shortly after birth developed an increase in size of the abdomen which in a few weeks became very well marked. The child for days would pass no urine; when he did pass it, it was in large amounts and showed nothing characteristic. When two months old the boy had an evident three-lobed tumor, one lobe in the middle abdomen coming out of the pelvis and rising to the level of the umbilicus; each loin was occupied by a lobe of the tumor, which represented, as autopsy showed, a much distended bladder, and a double hydronephrosis caused by a cystic protrusion into the bladder sufficiently large to block the urethral and other ureteral opening. Boström's second case (Case XIV), a boy of twelve, had been healthy up to his eleventh year. Then night incontinence began; six months later frequent, painful, and difficult micturition was present. At that time the abdomen began to increase in size, and a fluctuant, movable, non-sensitive, kidney-shaped tumor was found rising out of the

pelvis to the level of the umbilicus, its upper end free and its lower end fixed in the pelvis apparently to the bladder. The right loin was more resistant than the left, but no tumor could be made out there. In the left lumbar region could be felt a sausage-shaped mass. The urine was negative. The autopsy showed an atrophied left kidney, a much dilated left ureter, a distended bladder, and a marked right hydronephrosis, all the result of a cystic protrusion into the bladder blocking the urethral opening. These, of course, are marked cases and for that very reason are quoted somewhat at length.

Schwarz ⁵ in commenting on these cases makes some pertinent observations with regard to diagnosis. In such a case as Case XI, for instance, catheterization of the bladder, while it might remove some urine, would nevertheless not cause the median tumor to disappear wholly, and the tumors in the loins would be entirely unaffected. He calls attention to the possible significance of the long-continued retention of urine, alternating perhaps with involuntary micturition, which last would occur in the horizontal position with elevation of the pelvis because of the falling back of the distended cul-de-sac from the urethral opening. How practical these suggestions are is questionable. Much would depend, it seems to us, on the degree of distention of the cul-de-sac and the closeness of its application to the bladder wall.

The Cooper-Rose case (Case LI) also is instructive from a diagnostic stand-point. The patient, a woman of twenty-eight, had for thirteen years been treated for a supposed ovarian tumor, which occupied much of the left side of the abdomen. For eleven years the patient's general condition was but little disturbed. Then pain and discomfort began. After her death at the age of thirty it was found that the tumor was a huge left pyonephrosis secondary to a wholly impermeable left ureter.

This congenital condition may coexist with other surgical kidney affections. In Lilienfeld's case (Case XV) and in one of Mayo's (Case LII) a stone was found in the renal pelvis.

In both these cases the stricture was at the vesical end of ureter. In another of Mayo's cases (Case LIII) an almost complete stricture was found $1\frac{1}{2}$ in. below the kidney in the course of a nephrectomy for a tuberculous pyonephrosis. There was no explanation for the stricture other than on congenital grounds; the ureter below it appeared entirely healthy.

The urine is usually negative. Nichols's case and our case showed a moderate leucocytosis and a moderate rise of pulse-rate and temperature, but it is by no means clear that the ureteral condition had anything to do with this.

Infection will bring its usual train of symptoms. It is more to be feared in these cases because it may reach and affect the remaining sound kidney with disastrous results. The cystiform protrusions that have been of sufficient length to protrude from the external meatus, and have either sloughed or have been punctured, have invariably become infected, and always with fatal outcome.

Perhaps a knowledge of the existence of cases of congenital stricture of the ureter and of its results, and a more careful examination with that knowledge in mind, would have made a pre-operative diagnosis possible in Nichols's case and in our case at the Carney Hospital. However, in no case yet reported has such a diagnosis been made. The present widespread use of cystoscopy will render much easier the recognition and significance of the cystiform protrusion into the bladder. Young's case (Case VII) is illustrative of this fact. Ureteral catheterization and the X-ray (collargol plate) will find wider and wider use as aids in determining the location of strictures (Cases LII and LIII).

THE OPERATED CASES.

Cases have been operated on by Drew (Cases XXXV and XXXVI), Dudley Allen (XLVII), Wipple (XXIV), Mayo, Nichols, and the author. In no case was the diagnosis made previous to operation. Of Drew's cases one was cured and the other relieved, by pyelo-ureteroplasty, of the effects of con-

genital stricture near the renal pelvis. A perusal of his report makes one consider whether some of the cases instanced as examples of misplaced or abnormal origin of the ureter from the pelvis may not be more apparent than real, and whether the true situation may not be a pelvis so dilated through the effects of an ureteral obstruction (probably high) that its lowest level is forced below the point of origin of the ureter, thus causing that point to appear abnormally elevated. Again, his reports lead us to advise that in all cases of so-called idiopathic hydronephrosis not only should aberrant blood-vessels be sought for, but the calibre of the upper ureter should be carefully explored for stricture. To us these considerations appear practical.

The cases operated by Dudley Allen and by Wipple are also interesting, but for quite a different reason, in that they show how effective is a simple nephrostomy even in patients both of whose ureters must have been entirely obliterated at some point. In each case after a nephrostomy on one side all the urine escaped by the nephrostomy wound, none passing by the urethra. Wipple's patient, a woman of twenty-five, had had a right nephrostomy at the age of fourteen, and since that time had discharged all her urine through the operative opening; in her twenty-fifth year a left pyonephrosis made necessary extirpation of the left kidney. Recovery followed. Allen and Parker tell of a two and a half year old boy on whom a nephrostomy was done for a hydronephrosis filling the whole right side of the abdomen. Following this, practically all the urine was passed through the operative wound; yet the boy, aside from troublesome leakage about the tube, was perfectly well for over 12 years. Then nephritis showed itself and he soon succumbed. Autopsy disclosed a complete stenosis of the right ureter at the renal end and a congenital atresia of the left ureter near the bladder with a marked atrophy of the left kidney.

Drew in his cases circumvented the cause of the trouble. Wipple and Allen did away with its ill effects at least temporarily without removing the cause, but so far as I have

been able to ascertain Mayo's case, Nichols's case, and our case at the Carney Hospital are the only ones in which a successful removal of both cause and effect was possible and was accomplished. The history in brief of these three cases follows:

CASE REPORTS.

MAYO'S CASE (personal communication of Dr. E. S. Judd, first assistant surgeon, St. Mary's Hospital, Rochester, Minn.).—Female, married, aged forty-six. Seven years before consulting the Mayos she had passed bloody urine for a few days; at and after that time she had more or less pain in the upper left quadrant of her abdomen, varying somewhat in degree at different times, and shooting through to her back but never extending downward; each year she had one or two spells of bloody micturition; these were usually of only a few days' duration, but seven or eight months before entering St. Mary's she passed bloody urine for seven weeks, became pale, and for the first time thought she would have to give up and go to bed. Since that attack she had been feeling worse. Frequency of micturition had been a constant symptom, at first accompanied by pain, but of late painless. There was general abdominal tenderness and some resistance across upper abdomen, especially to left of epigastrium. Ureteral catheterization showed negative findings on the right; on the left, obstruction in the ureter near the bladder. Urine from the right side negative. At operation the left kidney and left ureter were removed. The kidney was hydronephrotic and the ureter was dilated to the size of the small intestine. It showed a stricture about one inch above the bladder. Recovery.

NICHOLS'S CASE.—Male, aged nine. Several days previous to entrance to hospital the child was seized suddenly with general abdominal pain and vomiting; the latter was not a prominent symptom. The pain had gradually grown worse and finally became localized over the appendix region; bowels were constipated. Before examination there was general spasm of the abdominal muscles, voluntary on the left side, both voluntary and involuntary on the right. Temperature 101° F., pulse 104; white count, 18,500. At operation the appendix was found to be normal. A large dilated kidney and a much dilated ureter were removed. There was a contraction of the ureter just below the kidney, and a more marked one (which would just take a fine probe) one-half inch above the bladder. Recovery.

AUTHOR'S CASE.—Male, aged six. One year before admission to hospital the boy had an attack entirely similar to that from which he was suffering at the time of his admission. He was in bed four or five days then. He was well from that time until two days before coming to the hospital, when he began to complain of abdominal pain, sore throat, and malaise. Vomiting fol-

lowed, and the abdominal pain became much worse and localized itself in the left lumbar region, shooting up the back; no bowel movement for forty-eight hours; never had shown any urinary symptoms of any kind; no muscular spasm of abdominal muscles. Temperature 101.6° F.; pulse 120; white count 16,400. A tender, sausage-shaped mass was palpable to the left of the spinal column above brim of pelvis. Though there was no history of blood-streaked mucus from the rectum, a probable diagnosis of intussusception was made. At operation a moderately large hydronephrotic kidney and a ureter dilated to the size of the small intestine were removed. There was a complete stricture 1½ in. above the bladder. The ureter was atrophied below the point of stricture. Recovery.

OBSERVATIONS ON DIAGNOSIS AND TREATMENT.

The diagnosis in any case is not a matter of ease. As has been said before, the present wide-spread and skilful use of the cystoscope, of the ureteral catheter, and of the X-ray will result in the relatively frequent recognition of the trouble, at least when it is present in adults; for to-day even unexplained frequency of micturition is sufficient ground for a cystoscopic examination. Lameness in the loin, pain, or an uncomfortable sensation there with some disturbance of urination should rouse our suspicions of a possible hydronephrosis. In children, the question is a more difficult one, and probably a large proportion of the cases will in them still remain undiagnosed. An increase in girth or a bulging in the loin may be the first sign in a child and should always lead to careful examination. Keeping in mind the possibility of the existence of such a pathological entity as congenital stricture of the ureter in its various forms will, I think, be a step in advance.

As to the treatment, the means must fit the case. It is evident that certain cases will require a nephrectomy and an ureterectomy. Nephrostomy may serve as an emergency measure. Paracentesis of the abdominal tumors is mentioned here only to be condemned, and yet Case LI demonstrates that even such a measure may afford at least temporary relief to a patient. Schwarz² speaks of the practicability of puncturing

from within the bladder the cystiform protrusions of blind-ending ureters, or of excising a portion of their walls. In women this would probably be a relatively easy matter through an operating cystoscope. In men, it would seem to be a matter of considerable technical difficulty. The combined intra- and extraperitoneal method of opening the bladder, advocated and practised by Harrington and C. H. Mayo, would, it seems to me, offer the best method of approach and of applying the necessary operative procedures to intravesical protrusions. In certain cases of cystic dilatation of the ureter just behind the bladder, ureterocystostomy might be practised.¹⁴ Perhaps, even here, removal of the kidney and ureter would prove wiser and safer.

It is probable that the future will see many more pre-operative diagnoses of the condition.

ABSTRACT OF CASES.

A. Cases Showing Protrusion into Bladder.

CASE I.¹⁵—Female, aged five and a half months, had been ill for 2½ months with vomiting, diarrhoea, and loss of weight as symptoms. Physical examination was negative except for a purulent discharge from her right ear. Autopsy: abdominal organs negative. The right kidney (6 cm. by 3.5 cm.) and the right ureter normal. The left kidney (8 cm. by 4.5 cm.) shows a dilated pelvis filled with cloudy fluid; the kidney substance shows marked atrophy and small areas of infection. Arising close together from a common pelvis are two ureters united by fibrous tissue; both dilated and filled with cloudy fluid. The anterior one averages 3.5 cm. in diameter, and the posterior 2.5 cm. The walls are thin and delicate. Both ureters run together till bladder wall is reached; the anterior passes through the wall and opens normally into the bladder; its dilatation ceases when it enters the bladder wall. A little below and to the outer side of this the smaller, posterior ureter penetrates the bladder wall and opens into a blind cystiform protrusion into the lumen of the bladder. The protrusion is 2 cm. in circumference and "is produced by an uplifting of the tissue of the inner wall of the bladder." It is filled with cloudy fluid, and does not connect with the bladder cavity or with that of the other ureter. When filled, it obstructs the opening of the other ureter of the same side and thus produced the hydronephrosis. Adrenals normal.

CASE II (Burckhard¹⁶).—Male, aged sixty-two, died of pneumonia. Double hydronephrosis, more marked on right. Both ureters open into bladder by very small openings at the tip of protrusions. Both ureters

dilated just above bladder and just before reaching pelvis. Both ureters thickened.

CASE III (Davies-Colley¹⁷).—Female, aged eighteen months. Left ureter shows a finger-like protrusion 1 in. long into lumen of bladder. Left ureter dilated to size of finger. Left kidney pyonephrotic (infection probably due to an attack of measles).

CASE IV (Beach¹⁸).—Female, aged five months. Well up to six weeks before death. Then trouble with urination began. Death in four days. Left kidney and ureter normal. The right kidney showed at its lower end an apple-sized cyst from which ran a supernumerary ureter opening by a very small aperture into a blind cystiform protrusion into lumen of bladder.

CASE V (Ogle¹⁹).—Pelvis of left kidney widely dilated; the renal substance deficient. The left ureter dilated to size of pencil. Into the bladder projects a cyst the size of a small pea. This cyst communicates by bristle-like openings both with the lumen of the bladder and with the dilated ureter.

CASE VI (Johnson²⁰).—Female, aged ten days. The right kidney enlarged and its pelvis distended; the right ureter dilated and curving. Left kidney, though imperfectly divided into two kidneys, has a continuous capsule. It has two ureters, both much dilated and tortuous; they join 1 cm. above point of entrance into bladder. Acute cystitis. The right vesico-ureteral orifice normal. "From the corresponding point on left side a protrusion covered with vesical mucous membrane extends downward, gradually increasing in size and ending in a bulbous enlargement, which with the parts in their natural position occupied the whole length of the dilated urethral canal and protruded externally between the labia. On its posterior surface the bulbous enlargement is attached to the floor of the urethra nearly as far as the orifice. On its right side the enlargement presents a long rent opening into the hollow interior, from which a probe can be passed upward into the ureter." The vagina, uterus, uterine appendages, and intestine were normal. Rupture of the bulbous enlargement occurred on the sixth day and child died of the subsequent infection.

CASE VII (Young²¹).—Male, aged forty-nine. Bloody micturition several times fourteen months before. No blood in urine since, though he has complained of frequency of micturition. Cystoscope showed a cyst, size of grape, at end of left ureter; pin-point left ureteral opening; the cyst swelled out every twenty seconds, carrying with it the ureteral orifice from which a fine stream came. As long as urine flowed, the cyst would remain dilated and would then collapse into a mass of wrinkled mucous membrane.

CASE VIII (Tangl⁴).—Female, aged sixty-seven. Right kidney and ureter normal; chronic interstitial nephritis of left kidney; congenital atrophy of left kidney; blind cyst-like projection of end of left ureter into bladder; gradual widening of lower section of left ureter; uterus bilocularis unicollis. From the posterior surface of left kidney comes a projection with three entirely distinct arms (4 mm. broad and 3 cm. long) which

merge into a common cavity (the true pelvis, 14 mm. broad), the lower end of which is continuous with the ureter (6 mm. wide). The part of the ureter just above the bladder gradually widens and passes directly into a pouch beneath the mucous membrane of the bladder, projecting into the vesical cavity. The cyst in the bladder, when full, is spherical and of the size of a walnut. It contains yellowish-brown, muddy, thin fluid and is situated much lower and nearer the urethra than is the opening of the right ureter.

CASE IX (Boström⁴).—Description of a pathological specimen. A cystiform projection of right ureter into bladder; left ureteral opening normal; no right ureteral opening. In its place is a finger-like projection of mucous membrane, 6.5 cm. long, flaccid in its empty state, pear-shaped when completely distended; its greatest transverse diameter is 5 cm., and this is gradually reduced in the direction of the tip which is 5 mm. broad. It has no communication with the bladder. Its inner lining of mucous membrane is directly continuous with that of the right ureter, and the ureter opens widely into the cyst-like protrusion. The ureteral wall is somewhat thickened and the opening into the cyst is abnormally widened (12 mm.). The specimen does not show the upper part of the ureter and the kidney. It must be assumed that the much dilated ureter and the kidney were destroyed by the highest grade of hydronephrotic atrophy. The bladder was large and showed muscular hypertrophy.

CASE X (Otto⁴).—Six months' foetus. Large abdominal hernia; malformation of cloaca and pelvis; liver without gall-bladder; small intestine ends in the cloaca; both kidneys without suprarenals; absence of right ureter; left ureter dilated, tortuous, and ends in a blind sac in that portion of the cloaca which would correspond to the urinary bladder.

CASE XI (Boström⁴).—Male, aged twelve. Apparently healthy up to the age of eleven and a half; then began to complain of urinary symptoms and to increase in girth; urination increased in frequency and in difficulty; strangury; the boy was well nourished. Abdomen, particularly between symphysis and navel, was considerably distended, and there was a non-sensitive tumor, dull to percussion, lying close beneath the abdominal wall between the symphysis and navel; the tumor was kidney-shaped and could be moved easily to the right or left. At the pelvic end it was fixed; the upper end was free; surface smooth; tensely elastic; on fixation undoubtedly fluctuant. There was more resistance in the right than in the left loin, though a distinct tumor could not be felt there. In the left lumbar region a long, sausage-shaped tumor with its long axis lying transversely could be rolled under the finger. It was fluctuant and was lying partially on the spinal column and behind the intestine. Urine showed a specific gravity of 1007, was acid, clear, with a trace of albumin and no sediment. Puncture of the tumor between the navel and the symphysis gave a watery, clear, light-yellow acid fluid without albumin or sugar; did not coagulate on standing; it contained no succinic acid and about as much chlorides as urine. The diagnosis lay between hydronephrosis and an echinococcus cyst. Double puncture of the two abdominal tumors was made with the hope of securing adhesion formation and a later oppor-

tunity of opening the tumors. Death from meteorism (?) (peritonitis). Autopsy showed congenital closure of the left ureter with cyst-like projection of the vesical mucous membrane. Enormous dilatation of the left ureter. Marked atrophy and abnormal position of the left kidney; renal blood-vessels abnormal. Marked hydronephrosis of the right kidney. Enormous dilatation of the bladder. The projecting vesical mucous membrane through its tense filling with urine completely closed the urethral opening so that urination was quite impossible.

CASE XII (Rott*).—Male, aged fifty-two, dead of phthisis. Right kidney absent with its pelvis and vessels. Near the side of the fourth lumbar vertebra began the right ureter which increased distinctly in volume as it went downward; in places it appeared lobulated. In the right vesico-rectal space it was crossed by the vas deferens, with which it communicated by a very fine opening. Below this point the ureter reached a diameter of over 2 cm., but was narrowed at certain places by shallow constrictions. It reached the base of the bladder at the normal place, but had no opening into it. In place of the normal opening was a half spherical cystiform protrusion into the bladder lumen; its base reached to the caput gallinaginis; the protrusion had a diameter of 2 cm. and the ureter opened into it by a gradually decreasing lumen. The portion of the ureter below the vas deferens and the protrusion formed an elastic fluctuating cyst with walls under high tension.

CASE XIII (Lechler*).—Female, aged three months. Shrieked with every urination. Labia majora pressed apart by a cyst (size of dove's egg); it was very tense and appeared to come through the vaginal opening. It looked like the bladder. It was replaced, but on the third day appeared again; urine suddenly shot out from it. Death in 28 hours. Right kidney and right ureter normal; left kidney was twice normal size and the upper half was cystically dilated. One ureter left the kidney in the usual way; from the cystic dilatation came a second ureter, which was widely dilated, shaped like a hen's intestine, and ran tortuously through cellular tissue down into the pelvis. Base and body of the bladder normal; vesical neck somewhat lengthened; urethra wanting; the neck of the bladder opened directly into the outer air. The bladder was then opened through its anterior wall and there appeared a "second bladder" which was the dilated blind end of the ureter from the cystic upper portion of the left kidney.

CASE XIV (Boström*).—Pathological specimen from the body of a 23-weeks-old girl. Shortly after birth there appeared a rather well-marked abdominal swelling which increased in size and which four months before death presented as a three-lobed tumor, one lobe in the centre joined with one in either kidney region. The median one rose out of the pelvis to the level of the navel; it seemed to be connected with the bladder. The child for days would pass no urine. When urine did come, it was in large amounts but showed nothing striking. Autopsy showed reduplication of both ureters; embryonic closure of one ureter with cystiform projection of vesical mucous membrane, which blocked the internal urethral opening and compressed the other ureteral openings; double hydronephrosis; marked dilatation and muscular hypertrophy of the bladder.

CASE XV (Lilienfeld *).—Pathological specimen from body of a male, aged sixty-five, dead of typhoid. At upper end of right kidney is a structure which is assumed to be a degeneration of the parenchyma. From the pelvis (contracted about a stone) of this portion of the kidney ran a ureter which proceeded with the normal ureter (joined to it by connective tissue), penetrated the bladder somewhat below it, and ended in a cystiform protrusion (filled with clear liquid) into the bladder lumen.

CASE XVI (Heller *).—Female, aged seventy-nine, dead of pneumonia. Autopsy showed an enormous, fluctuant cyst, arising from the right side and filling the whole abdominal cavity; scanty remnants of renal substance in the wall of the cyst; in bottom of sac was an opening which led into a dilated (2-3 cm. wide) ureter with a thick, flabby wall; the ureter ran with many twistings and turnings down to the bladder and ended blindly in a cystiform protrusion into the vesical lumen. On the anterior surface of the cyst was a flattened kidney, from the pelvis of which a ureter led down and opened into the bladder above the other ureter of the same side. On the left, the otherwise normal kidney was separated into an upper and lower half, each with a fairly normal pelvis; from each pelvis ran a ureter; these joined just before reaching the bladder and opened into it by a common trunk.

CASE XVII (Geerds *).—Female, three weeks old. Child had complained for eight days of a diarrhoea and abdominal distention. Suddenly a tumor appeared at the vaginal opening. It came through the urethra and could be pressed back through it. A plastic operation was done on the urethra, but the tumor soon appeared again and finally sloughed. The child died of what seemed to be general peritonitis. Autopsy showed a general peritonitis; right kidney and ureter normal; on the left side a double renal pelvis; both dilated, especially the upper, which was filled with pus; from the lower ran a normal ureter which opened normally into the bladder; from the upper pelvis a dilated ureter ran down and ended in the bladder in a cystiform protrusion, which had finally passed through the urethra and formed the tumor mentioned above.

B. Cases Showing no Protrusion into Bladder.

CASE XVIII (Welz *).—Child, aged two and a half months. Ill four weeks. For the first two weeks had convulsions; then followed a week of quiet; almost continual convulsions since. No vomiting; stools yellow and thin; abdomen somewhat distended but soft. Autopsy showed a lobulated left kidney; capsule easily removed; right kidney somewhat larger; both ureters dilated, the right more than the left; rather small, somewhat thickened bladder with pale mucous membrane; opening of right ureter into bladder obliterated; hydronephrosis of both kidneys; internal hydrocephalus.

CASE XIX (Meschede *).—Left kidney absent. Right enlarged more than half. In the bladder the ureteral orifice was present only on right side. Where the left one should have been was only a dimple in the mucous membrane. On the outer bladder wall, corresponding to the loca-

tion of the dimple within, was an embossed cyst the size of an egg, from the upper part of which ran a hollow cord which communicated with the cyst at its lower end, but which ended blindly above in the subperitoneal tissue at a point a finger's breadth below where left kidney should have been. Yellowish fluid in the cyst.

CASE XX (Vignier').—Atresia ani; small kidneys and dilated ureters. Left kidney larger than right; the left ureter goes to the bladder without opening into it; the right ureter does not connect with the bladder; its lower end narrows suddenly and connects with the rectal ampulla by an opening as fine as a hair.

CASE XXI (Otto').—Monster. Abdominal hernia, which includes the liver, gall-bladder, stomach, pancreas, spleen, and small intestine. Behind the hernia were two kidneys; left kidney smaller; left ureter absent; right ureter ends in cloacal wall.

CASE XXII (Otto').—Monster. Abdominal hernia; spina bifida; cloaca; two suprarenals; wide, tortuous ureters which end in blind cysts not connecting with the bladder. Uterus, tubes, and ovaries reduplicated.

CASE XXIII (Montmollin').—Full-term child. Arrest of development of intestine and urinary organs; atresia ani; large intestine ends in blind sac at level of promontory; similar ending of left ureter; right ureter connected with bladder by a fibrous cord.

CASE XXIV (Wipple').—Female, aged twenty-five. At fourteen years of age symptoms of right-sided hydronephrosis appeared, which indicated nephrotomy. All the urine flowed through the operative fistula; no urine came from bladder. In her twenty-fifth year, severe pain and tumor formation in region of left kidney; incision, evacuation of pus, and later extirpation of the left hydronephrotic sac; left kidney atrophied. Recovery. There must have been congenital strictures of both ureters.

CASE XXV'.—Alcohol preparation of eight months' foetus, dead of suffocation. Beginning double hydronephrosis due to congenital atresia of ureters at vesical openings. Slight dilatation of both ureters.

CASE XXVI (Weigert').—Specimen showing the abdominal and pelvic organs of a new-born, full-term child. Perineum included in the specimen; no anal opening; rectum and large intestine much dilated; small intestine, liver, biliary passages, and stomach normal; left ureter opens into bladder normally; it is 14 cm. long, is dilated, and opens above into a dilated pelvis; calyces distended, papillæ flattened; otherwise, kidney and suprarenal normal. On the right side, no vesical opening of the ureter. The rectum opens into urethra near caput gallinaginis. In place of right kidney is a conglomeration of cysts to which go vessels from the aorta forming a sort of hilus; from the conglomeration of cysts goes out a ureter which for a distance of 2.4 cm. has a visible lumen, and is then continued as a solid cord to the posterior surface of the bladder, where it is lost. No right seminal vesicle.

CASE XXVII (Mutach').—Male; died thirty hours after birth. Tumor (size of fist) in right kidney region; it extended toward median line and down into pelvis. Right kidney showed marked cystic degeneration; cysts were thin walled and contained clear fluid. Opening of right ureter

into bladder had a circumference of 2 cm., but the ureter narrowed as it extended upward and was obliterated 5.5 cm. from kidney. It soon again showed a lumen and retained it till it reached the hilus and communicated by a minute opening with a calyx. The left kidney was simply a conglomeration of cysts containing clear fluid. The left ureter had a normal vesical opening, but was completely obliterated 2 cm. above it, where it formed a fibrous cord, which, near the kidney, again took on a lumen which could be traced with a sound only to the hilus. Closer examination proved that it connected with a calyx as did the right ureter.

CASE XXVIII (Haviland³).—Male, aged eighteen. Well up to 12 years of age when he fell 20-30 feet. He seemed to be only shaken up and a quick recovery followed. Since then, however, he had had painful urinary incontinence; blood and pus in urine; autopsy showed left kidney degenerated into a number of sacs with contents resembling pus. Each sac was separated from its neighbor by a distinct membrane. An outlet from these sacs was not to be found. The left ureter was atrophied, impermeable, and surrounded by a thick layer of fat. The right kidney was pale and hypertrophied, and had at each end a cavity containing pus. The right ureter was much dilated and surrounded by fat and many indurated lymph-vessels.

CASE XXIX (Osterloh⁴).—Girl, new-born. Double ureter on left side. The left lower ureter normal; the left upper ureter dilated and ended blind in a cyst behind the bladder. Upper half of left kidney was hydronephrotic.

CASE XXX (Stoltz⁴).—Right side of uterus well developed; the left horn had tube and ovary but was atrophied. The right kidney had two ureters; the upper ran from a sort of thick-walled cyst downward to end blindly in the bladder wall on the left side. The lower ureter was entirely normal. There was no trace of left kidney.

CASE XXXI (Teyssèdre⁵).—Male, aged one and a half years, dead of measles. Congenital absence of right kidney; right suprarenal present; atrophy of right renal vessels; both ureterovesical orifices normal; right ureter permeable from bladder to level of iliac fossa; from there to the place where right kidney should be it is only a fibrous cord. The other genito-urinary organs are normal.

CASE XXXII (Ferrand²).—Male, aged four and a half years, dead of diphtheria. Left kidney absent; left pelvis represented by a closed cyst, from the outer wall of which a dilated ureter ran down to a cystiform dilatation outside the posterior bladder wall.

CASE XXXIII (Fenwick²).—Specimen from a male, aged sixty, dead of cerebral hemorrhage. Right kidney enlarged but healthy; left kidney represented by a stiff-walled, multilocular sac of the size of a goose-egg and containing a thin, white, opaque fluid glistening with cholesterol crystals. Wall of cyst is calcified. Left ureter is an impervious cord; no left ureterovesical opening in bladder.

CASE XXXIV (Pelissier²).—Male, aged twelve. For years abdominal pain radiating into the loins; occasional inability to urinate, and finally loss of control of urination. The abdominal pain grew worse, fever

began, and boy's condition became hazardous. Abdomen distended and tender. Below was a central dull area reaching to the umbilicus; flanks clear; fluctuating tumor parallel to right groin. The X-ray showed a vesical stone which was removed suprapubically; drainage; no improvement; death. Autopsy showed abdominal organs normal; right ureter distended to size of thumb; right kidney enlarged; left ureter size of small intestine; both kidneys were simply pockets of pyo-uronephrosis; parenchyma practically destroyed. Ureters could be catheterized only in a retrograde way and then only with filiforms, because of punctiform openings (like openings of lachrymal ducts) into bladder. This was evidently a congenital deformity which probably began in infancy and was progressive; infection came through formation of stone in bladder.

CASE XXXV (Drew²³).—Female, aged thirty-four. Tumor in left loin for four years; it gradually increased in size, and pain as well as frequency of urination were accompanying symptoms. Operation: one pint of urinous fluid from renal pelvis; renal substance considerably damaged, but the organ was obviously still good; stricture ($\frac{1}{4}$ in. long) of ureter just as it entered pelvis. The stricture was not cicatricial but evidently congenital; it would just admit a probe. The ureter entered the hydronephrotic pelvis $\frac{3}{4}$ in. above its level: pyelo-ureteroplasty resulted in cure.

CASE XXXVI (Drew²³).—Female, aged fifty. Tumor in left abdomen for $1\frac{3}{4}$ years. With its gradual increase in size pain began, and there was increased frequency of micturition. Operation: $1\frac{1}{4}$ pints of urinous fluid from the pelvis. The kidney substance was not damaged. The upper four inches of ureter was much narrower than normal; orifice would just take a probe. Ureteral orifice enlarged by a pyelo-ureteroplasty. Marked improvement four months after operation.

CASE XXXVII (Corsy²⁴).—Autopsy subject, dead of tuberculosis. Right kidney was normal, except that pelvis is slightly distended with a clear liquid that cannot be forced out; four cm. below the pelvis the ureter shows a stricture which diminishes the ureteral calibre by one-half. On the left side there is no hydronephrosis, but at the same level as on the other side there is an ureteral stricture which is not so well marked. Pathological stricture is out of the question; there is no elbowing, and no aberrant vessel.

CASE XXXVIII (Shield²⁵).—Male, aged seven months, complained of diarrhœa and vomiting for three weeks. On the right side completely filling the loin was a large mass, firmly fixed, apparently solid and palpable by rectum. Death. Autopsy showed the mass to be an enlarged right kidney of the size of a cocoanut. Right ureter ended in a fibrous cord; no opening into bladder; upper part of ureter much enlarged (2 inches in circumference); it coiled downward into the pelvis, which is almost completely filled by it; it pressed on the rectum and left ureter, which with the left kidney is enlarged and hyperæmic. The disorganized right kidney and the right ureter were filled with yellow pus, the source of which was unknown.

CASE XXXIX (Auscher²⁸).—Male, aged one and a half years, dead of measles. Left kidney slightly enlarged; right kidney of the size of a bean, had arteries going to it. In the bladder there was nothing abnormal. In the pelvis and iliac fossa the right ureter was normal but slightly smaller than the left; just as it clears the fossa it diminishes rapidly in size and runs as a thin impermeable cord to the rudimentary right kidney. Testicles, vas deferens, etc., normal.

CASE XL (Handford²⁹).—Male, aged nineteen. Great foot-ball player. He was seized suddenly with acute chorea and was sent to an asylum; death in fourth week of illness. Autopsy showed a much enlarged left kidney; the right kidney was represented by a cyst (size of a filbert). The right ureter, dilated to the size of the small intestine, contained clear fluid. Both ureteral openings were present in bladder, but a probe passed into the right ureter met an impassable obstruction $\frac{1}{2}$ inch above opening; right adrenal normal; right renal vessels atrophied but normal in origin and course.

CASE XLI (Pitt³⁰).—Male, aged twenty-two, killed by train. Left kidney distended and its pelvis considerably enlarged; the left ureter at its junction with the pelvis was very small and would just take a probe the size of a No. 2 catheter. The kidney structure was practically normal.

CASE XLII (Ord³¹).—Male, aged one year, dead of anæmia; hydro-nephrosis (side not mentioned) due to stricture at point of exit of ureter from renal pelvis; kidney dilated and contained urine turbid with pus-cells.

CASE XLIII (Pollock³²).—Male, aged sixty-two. Twenty years before he had had dropsy and general anasarca. Except for dizziness he had been well since then till very recently, when attacks of suppression of urine began; death from uræmia; autopsy showed an atrophic, cystic left kidney; the left ureter is impervious throughout its whole course and has no opening in the bladder; right kidney large and healthy. The right ureter was plugged at its lower end by a calculus.

CASE XLIV (Sainsbury³³).—Female, aged thirty-four, dead of uræmia. Right kidney shows advanced nephritis. Right ureter patent; left kidney represented by a pyonephrotic sac filled with a soft, thick paste; left ureter patent in upper two-thirds, but calibre was lessened. Two small, valve-like flaps at the same level effectually closed the outlet of the pelvis into the ureter; lower third of the ureter impermeable; no opening into bladder; the valves and the impermeability congenital. In this case the impermeability of the lower third of the ureter was a potential rather than an actual cause of obstruction.

CASE XLV (Pitt³⁴).—Young adult. The left kidney was hypertrophied; the right kidney only half normal size; thick, dense stricture of right ureter about $\frac{1}{2}$ inch from renal pelvis.

CASE XLVI (Penrose³⁵).—Male, aged twenty-five. There was an absence of upper two-thirds of left ureter, and the left kidney was very small and cystic.

CASE XLVII (Allen and Parker³⁶).—Male, aged two and a half years, seen May, 1889, with a markedly enlarged abdomen due to a

collection of fluid filling the whole right side. Operation. A greatly distended kidney held the collection of fluid. An attempt to shell it out had to be given up because the child was in poor condition. Drainage. Patient recovered from the operation. For a few weeks he passed a few drachms of urine *per urethram*. After this time all passage of urine by the natural channel ceased, and up to the time of his death (February, 1902) he passed no urine whatever except through the operative opening in his side. Apart from the annoyance of wearing a silver tube in the opening which discharged constantly into a rubber bag, and apart from the fact that no satisfactory way could be devised for collecting the urine at night, the boy was perfectly well, went to school, etc., and appeared to be in normal health till June, 1900. Then the tube began to trouble him greatly and he was much annoyed by leakage of urine around it. Under ether, the opening was enlarged. He was not seen again till January, 1902. Then he looked pale, had had a severe hemorrhage from his nose and a considerable discharge of blood from his side. He showed slight œdema of his face and legs and an enlarged heart. The hemorrhage from the kidney continued and the boy died of uræmia in February, 1902. Autopsy showed complete stenosis of right ureter at renal end; slight dilatation of right ureter, associated with valve-like folds in the mucosa. Hemorrhagic pyelonephritis with marked distention of the right kidney; fistula between lower end of right renal pelvis and abdominal wall; hypertrophy of right kidney with acute and chronic nephritis and pressure atrophy; the left ureter lobulated and looking like a string of sausages, bow-shaped, dilated (3-4 cm. in diameter), and nearly filled with 200 c.c. of clear, amber-colored fluid which flows freely from one part to another; the ureter extends to the bladder but does not communicate with it. On section the walls are thin, and valve-like folds are seen narrowing its lumen in places. Mucosa normal in appearance; left renal pelvis slightly enlarged and envelopes about two-thirds of circumference of kidney. It communicates only with a single calyx. Left kidney shows chronic interstitial nephritis with marked atrophy.

CASE XLVIII (Förster').—Still-born male fœtus (seven to eight months). Left kidney and ureter absent; left suprarenal (larger than the right) lay in its usual place; right kidney, somewhat larger than normal, was in the usual position; its calyces and pelvis somewhat dilated; no suggestion of double kidney; the right ureter is much dilated and runs tortuously beneath the lower end of the colon to open in the left side of the bladder at the exact place where, under normal condition, the left ureter would open; the orifice is very narrow and takes the smallest probe. Where the right ureter should open normally there was no trace of an opening.

CASE XLIX (Billard").—Child, aged one month. Huge hydronephrosis; the left ureter terminates normally in bladder, but above forms two thin impermeable strings joined to the renal pelvis by a series of cords.

CASE L (Thurmann").—Large congenital hydronephrosis due to an entirely impermeable ureter.

CASE LI (Cooper-Rose¹).—Female, aged twenty-eight years. Under treatment for thirteen years for supposed ovarian tumor. When she was fifteen, an indistinctly fluctuant tumor (size of fist) was felt in region of left ovary. For two years before that time there was occasional hæmaturia; after the discovery of the tumor, frequent attacks of hæmaturia. The tumor grew rapidly and in three years occupied the whole left side of the lower abdomen; much pus and blood in urine; for eleven years her general condition was but little disturbed; then distention of the abdomen and pain began, and a fluctuating area made its appearance between the navel and the crest of the left ilium. A needle was introduced and seven pints of hæmo-purulent fluid containing no urinary salts was withdrawn. Following this the tumor grew much smaller (size of fist), but the fistula remained open and discharged pus. Death two years later. Autopsy showed a large cystic tumor (6 in. by 3 in.), occupying place of left kidney; no kidney substance; cyst contained blood and pus. The left ureter was a solid cord. The right kidney showed parenchymatous nephritis.

CASE LII (Mayo²).—Female, aged forty. For seventeen years patient had frequent attacks of rather typical renal colic on left side; the usual pain was complained of; blood and pus in urine; fever and chills at times. Attacks have increased in frequency of late; left kidney area tender; tenderness in left iliac fossa; right kidney palpable; cystoscopic examination showed "roughening in left ureter; urine coming from that side." X-ray (collargol plate) disclosed "obstruction of left ureter near bladder; hydro-ureter." Operation. Hydronephrosis with stone in pelvis of kidney; stricture of ureter ("probably congenital") $\frac{3}{4}$ in. above the bladder; kidney and ureter removed; ureter dilated to size of small intestine. Recovery.

CASE LIII (Mayo³).—Male, aged twenty-four. For five years patient had frequent urination day and night; smarting and pain in penis before and after urination; pus in urine for some months; some years before some blood in urine; three attempts (the last under ether) failed to catheterize the entire left ureter. Operation: nephrectomy for tuberculous pyonephritis; stricture of left ureter $1\frac{1}{2}$ in. below kidney; it was almost complete; the ureter below it looked healthy. Recovery.

Cases LIV, LV and LVI will be found in text.

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PRIMARY (CONGENITAL) HYDRONEPHROSIS.

REPORT OF A CASE WITH REMARKS ON THE TREATMENT AND PATHOLOGY.

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CONGENITAL, or speaking more correctly, primary hydronephrosis is not what may be termed infrequent, while the acquired form is very rare in children. The latter may be the result of ureteral compression by a malignant tumor, by adhesions resulting from a tuberculous peritonitis, or an hydatid cyst of the under surface of the liver. Uric acid sand has been said to be the most frequent factor, as it accumulates at either the upper or lower ureteral orifice, causing obstruction of the lumen. The affection is apt to be bilateral, and the hydronephrosis usually is only incomplete and partial. The renal enlargement is not excessive. Dilatations occur in the ureter, but the renal pelvis may not of necessity become dilated. It may occasionally result from a ren mobilis, just as occurs in the adult.

The primary or congenital type is nearly always due to malformation of the ureter, such as absence or stricture of the tube, but sometimes the pathogenesis remains very obscure, exploration of the ureter showing it to be apparently perfectly normal.

i. The case that I have to report occurred in a girl, two years and eight months of age, who was referred to me in November, 1903. There was little of interest in the past history excepting that she had always been a rather weakly child. About seven months before seeing the patient, her mother had noticed some distention of the abdomen, and this had gradually increased. At the same time the child complained of pain each time the bowels moved, and there was some diarrhoea. The patient was referred to me with a diagnosis of probable tuberculous peritonitis.

Examination showed that the bony structures and muscular tissue were fairly well developed, but that of late the child had been losing flesh. The abdomen was greatly distended and by inspection it was evident that the left half was decidedly more so than the right. By palpation a tumor could be distinctly made out protruding from under the left costal border and extending towards the middle line nearly to the umbilicus. The fingers could be made to enter between the lower pole of the growth and the iliac bone. The surface was smooth and uniform, the tumor was immovable but showed slight synchronous movements with the respiration. By pressure with the hand some gurgling could be elicited over the surface, showing that some intestinal coils were present between the growth and the anterior abdominal wall. The tumor felt quite hard, fluctuation could not be made distinctly evident, but a liquid thrill was obtained by tapping the side of the abdomen with the finger. The right half of the abdomen was somewhat tympanitic, while percussion showed that there was a uniform dullness over the entire extent of the growth.

The urine was voided in sufficient quantity, was a light yellow in color, acid in reaction, and microscopically presented nothing abnormal.

The diagnosis lay between a malignant renal growth and hydronephrosis. The child was placed under observation for several weeks, but no change occurred, and given the thrill obtained by tapping the growth with the finger, it was evident that fluid was present, so that a diagnosis of primary hydronephrosis was made.

I would also say that the temperature was at no time raised and that the urine, which was carefully followed, never diminished in amount and never presented any pathologic products during the several weeks that the child was under observation.

Operation was advised and accepted and was performed on December 27, 1903. An incision, beginning at the external border of the spinal muscle mass, was carried from the tenth rib downwards and transversely to the iliac crest; the exposed kidney then protruded into the wound and distinct fluctuation was evident. An incision into the cyst gave exit to 1300 c.c. of fluid (some more of which was lost). It was a straw-colored, slightly cloudy liquid which, upon examination, showed a large amount of albumin and some urea.

After the liquid had been evacuated, the sac collapsed and could then be drawn out through the wound to a certain extent, but it was very adherent in the region of the upper pole and towards the vertebral column. When it had been completely freed after a rather difficult dissection, it was found that the pedicle was very atrophied, the renal vessels having almost disappeared, while a stricture was found in the ureter about 5 c.c. below its junction with the renal pelvis, which completely occluded its lumen. The wound was sutured excepting at its upper angle, where a cigarette drain was inserted.

On the following day the temperature was normal, the pulse 101, and the general condition good. The quantity of urine passed in 24 hours amounted to 800 c.c., and analysis showed that it was exactly as before the operation.

The child made an uninterrupted recovery in spite of an intercurrent attack of bronchitis, and was discharged three weeks after the operation. I saw the patient in May, 1908, consequently four years and a half after the operation, at which time she was a well-developed girl and had enjoyed good health ever since the interference.

Examination of the cyst showed that its walls varied from 4 to 7 mm. in thickness, while at the anterior aspect of the lower pole its thickness reached its maximum. Microscopic examination of this part of the sac showed, in the first place, a large amount of connective-tissue growth. At various points a large number of uriniferous canals were found, whose epithelium only took the stain slightly and most of it had desquamated. The nuclei did not stain at all and the uriniferous canals were choked by the shedding of the epithelium. No normal glomeruli could be detected, but their remnants were present. Evidences of a capillary circulation were present, but, apparently, the vessels had lost their functions. From this examination it is evident that we have the picture of a severe interstitial nephritis.

In the *Pathological Transactions*, vol. xi, is to be found a very interesting paper by Griffiths, entitled, "The Histological Changes in the Kidney in Hydronephrosis." He does not consider the changes, such as occurred in our case, as a direct result of pressure exerted on the renal calyces, which in turn causes an interstitial overgrowth of connective tissue with a

complete disappearance of the uriniferous canals, but he explains the process which leads to such changes in the renal parenchyma in a somewhat different manner. According to his way of thinking, these occur only when the renal pelvis is greatly distended, resulting in a distention and flattening of the renal vessels, which also become contracted by a form of arteritis and endarteritis.

Referring to the stricture of the ureter found in the case reported, I believe that it is more than probable that it had developed before birth and should be considered as a congenital defect. It must have been partially patent for a time at least, and little by little contracted down so as to completely occlude the lumen of the canal and thus gave rise to the complete hydronephrosis. Then, again, the hydronephrosis must have been present for some time on account of the very marked and advanced renal atrophy. It is also quite possible that a dilatation of the renal pelvis had been present since birth, and little by little became more and more distended as the ureteral stricture narrowed down.

The location of the tumor in the left half of the abdomen, extending down to the bony pelvis, might have been either a splenic or renal growth, but that it was retroperitoneal was made evident by the presence of a few intestinal coils between the tumor and the anterior abdominal wall. Since a thrill without any evident fluctuation could be elicited, it was evident that the contents were fluid, and, therefore, a malignant growth could be practically eliminated.

In female children a large primary hydronephrosis might be mistaken for an ovarian cystoma, but a differential diagnosis may be readily arrived at from the fact that when arising in the ovary the cyst, as it develops, pushes the intestine to one side and the coils are never found between the growth and the anterior abdominal wall. Then, again, rectal or vaginal examination will make the diagnosis of ovarian cyst certain. The contents of a hydronephrotic cyst are distinguished from those coming from an ovarian cystoma by the larger amount of urea they contain. It is quite true that urea may be

absent in the fluid from a hydronephrosis, when atrophy of the renal parenchyma has reached such an extent that no normal uriniferous canals are present.

Of other renal growths an echinococcus cyst is the most likely to cause confusion, but in these cases an exploratory puncture will reveal the true nature of the affection.

Malignant disease of the kidney is not infrequent in children, and the growth may be of such soft consistency as to give rise to pseudofluctuation.

Very frequently a differential diagnosis between a hydronephrosis and a congenital cystic kidney can hardly be made, but in the former one may usually elicit a pronounced fluctuation. Then, again, in the polycystic kidney the growth is almost always noticed from the time of birth. However, an absolute diagnosis may not be reached in many cases, but from a practical standpoint, this is of no great value, because in both, surgical interference is indicated. In typical cases when the hydronephrosis is not due to the closing down of a ureteral stricture, we get many characteristic symptoms, such as the occurrence of renal colic, intermittent polyuria which results in a decrease in the size of the swelling, all of which are sufficiently characteristic to render the diagnosis an easy matter.

Regarding the treatment of primary hydronephrosis opinions vary, but it would seem to me that all liquid tumors require an early operation, provided that the other renal gland is carrying out its normal functions. The polycystic kidney, being usually bilateral, should be left alone. However, the process may involve but one kidney and produce compression symptoms, but it is just in these cases that the true nature of the lesion is not diagnosticated, because the affection is here unilateral. If the other kidney is healthy, nephrectomy may be done, but one should always recall that at a later date the remaining kidney may, and undoubtedly will, undergo the cystic change.

No single operative interference can be applied to primary hydronephrosis in children. If it should be the result of a

nephroptosis, fixation of the kidney may alone be required, and, if the functions of secretion are sufficient, some one of the plastic operations on the ureter and renal pelvis will find its indication. If the surgeon is convinced that the diseased kidney possesses no functional value, I believe that nephrectomy should be done when possible, preferably by the extraperitoneal lumbar route. Nevertheless, many operators are not of this opinion and prefer nephrotomy. Küster has reported 11 cases in which he successfully performed nephrotomy for hydronephrosis and only one resulted in a fistula. Mendelsohn and Wagner are of the opinion that it is a mistake to deal with a hydronephrosis other than by nephrotomy. They believe that, in those cases where a good result can be obtained by a simpler interference, nephrectomy is a too severe operation, and is also contraindicated because it should be the endeavor of the surgeon to save every bit of functionally active kidney parenchyma that is possible, not only for the ultimate welfare of the patient, but also to avoid the appearance of uræmia where there is a possibility of some pathologic involvement of the other kidney, which, in some cases, cannot be diagnosed before the operation.

This opinion is also accepted by Geiss, who, out of 18 cases of hydronephrosis upon which he operated, only twice performed primary nephrectomy and five times secondary nephrectomy. Nephrotomy was done on all the other patients, and in nine of them a complete cure resulted. There was one death after primary nephrectomy.

An exactly diametrically opposed opinion is upheld by Jeannel, who, on both statistics and theoretical conclusions, believes that only in the most infrequent cases can a cure of a large hydronephrotic sac be obtained by nephrotomy, and as secondary nephrectomy is always more difficult than a primary one, as it always has a more unfavorable prognosis, he concludes that, under these circumstances, primary nephrectomy is proper, provided that the remaining kidney is functionally healthy. Von Bergmann is also of this opinion and has performed nephrectomy twenty-one times for hydronephrosis.

primary hydronephrosis, particularly as encountered in childhood. There is no doubt but that this lesion when encountered in adult life may, in many instances, have a congenital origin, because the conditions found can easily be traced back to an abnormal development at birth. Some writers even go so far as to consider all instances of primary hydronephrosis as a result of some anomaly of the urinary tract having a congenital origin.

The degree of dilatation of the renal pelvis depends entirely upon the extent of the obstruction offered to the flow of urine. If this is of mild degree the dilatation of the renal pelvis will be only moderate. This will then produce a flattening of the papillæ and dilatation of the cortex. A more marked dilatation will cause compression of the cortex, so that the uriniferous canals, as well as the glomeruli, become flattened, and thus atrophy of the latter is not infrequently brought about. All these changes are accompanied by a hypertrophic overgrowth of the connective tissue, and finally the sac may reach such a degree as to contain several litres of fluid.

A hydronephrosis may not always result in this cystic dilatation, for one not infrequently encounters a congenital hydronephrosis combined with cystic degeneration of the kidney. This type, however, is to be distinctly distinguished from a simple primary hydronephrosis. Although the clinical differentiation between these affections is a difficult affair, the pathologic finding is very different and the causative factor is not uniform. Macroscopically cystic degeneration of the kidney differs from a primary hydronephrosis in that the kidney is not transformed into a single large cyst, but is converted into a number of small cysts, varying from the size of a walnut to an apple, while microscopically atresia of the papillæ is found, the cause of which has been supposed to be an intra-uterine inflammation. On account of the distention and congestion arising in the uriniferous canals, a cystic enlargement results within them, which then develops into a cystic kidney. On the other hand, cystic transformation of the kidney resulting from a hydronephrosis is merely due to pressure of the pent up urine in the renal pelvis.

Many cases of primary cystic kidney due to an obstruction of the ureter or urethra, which, in the first place, produces a dilatation of the renal pelvis, have been reported. For example, Von Mutach in his paper entitled "Genese der Cysten-niere," which appeared in 1895 in *Virchow's Archive*, describes a case of congenital cystic kidney with obstruction of the urethra and a hydronephrotic renal pelvis, and another one in which he found occlusion of the ureters. It is evident from the report of these cases that in the first one a hydronephrosis developed, followed by a transformation of the kidney into a single large sac due to an obstruction in the urethra, while in the second case a so-called congenital cystic kidney developed as a secondary process to the dilatation of the kidney.

If Virchow's theory of intra-uterine inflammation be accepted, it might be possible to find in this the cause of stricture of the ureters, as well as an atresia of the renal papillæ. In those cases where occlusion of the ureters is found accompanied by a congenital cystic kidney with a dilated renal pelvis, one could explain the process as follows: as the result of an intra-uterine inflammatory process, the exact cause of which is not as yet fully explained, an atresia of the ureters occurs which gives rise to distention of the renal pelvis, and then, as a result of the back pressure and ascending extension of the inflammatory process, atresia of the papillæ arises, during the development of which cystic disease of the kidney occurs. It could then be taken for granted that, in those instances in which there is a complete occlusion of the ureter, a hydronephrotic dilatation of the renal pelvis with the above-mentioned resulting lesions is found, which is not in the true sense of the word a congenital cystic kidney. The inflammatory process is confined in the first place to the ureters without having extended to the papillæ.

Other writers attribute the obstruction in the ureter to a disturbance in the development and not to an inflammatory process, while others are of the opinion that the hydronephrosis is the direct causal factor of the cystic kidney. If this be accepted, it remains unexplained why, when a hydronephrosis

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is present, the renal parenchyma should transform into a cystic sac with atrophy of the kidney structures, because the latter condition is found quite as often when the excretory urinary tract is perfectly normal, so that the reason for its production must still be sought for in other circumstances. Thus, a few writers believe it to be due to some developmental interference, while still others are inclined to assume that these cystic kidneys are nothing less than a cystadenoma.

Referring now to the causes of the production of a primary hydronephrosis, it may be said that occlusion at some point of the excretory urinary tract is only one among many, but there must always be an obstruction to the flow of urine at some point which leads to distention of the renal pelvis, first among these to be mentioned being a partial or complete occlusion of the ureter or urethra. Several cases have been recorded where a partial or complete obstruction of the urethra has resulted in a dilatation of the renal pelvis, which naturally involved both kidneys.

Thus Billard found hydronephrotic changes in a newly-born infant which resulted from an obliteration of the urethra situated just behind the external meatus. A case of a child fourteen days old having complete retention of urine from birth has been reported by Schuchardt; catheterism revealed an obstruction in the urethra which was finally overcome by repeated passage of the catheter. The child had a distended abdomen when born, so that it is evident that a hydronephrosis was at that time present. It died, and autopsy revealed an extreme dilatation of the bladder, ureters, and renal pelves. It is evident from all this that even a mild obstruction of the urethra in the newly-born may in reality be a most serious affair.

Rindfleisch has recorded an interesting case of occlusion of the urethra which resulted in hypertrophy of the bladder and hydronephrosis. The subject was a male child five weeks old who developed pleuritis, but had given no evidence of any symptoms in the urinary tract. Autopsy showed a soft elastic tumor the size of a small pea at the caput gallinaginis. The sinus prostaticus was widely patent, but no opening of the ejaculatory ducts could be found. On the other hand, where these openings should have been there was a dilatation and thickening of the blind end of the spermatic cord and this had caused the swelling of the caput and had displaced the lumen of the urethra so that an occlusion resulted.

That slight stricture of the urethra may have a very unfortunate result is made evident by a case recorded by James, in which an eight-year-old boy suffered for several years with urinary symptoms and finally died in coma. Autopsy showed that the bladder wall was greatly hypertrophied.

while the renal pelvis on both sides was greatly distended and all these changes had arisen from a tight phimosis. Mr. D'Arcy Power has also called attention to this cause of hydronephrosis in his book on "The Surgical Diseases of Children."

Schuchardt has attempted to explain these extensive changes in the renal pelvis, as follows: in children he maintains that the muscular structures of the bladder are not sufficiently strong to overcome the increased demands, the voluntary impulse to void urine is not so developed, and consequently the bladder may become readily overdistended with much greater ease than in the adult. Now, since the vesical walls are much thinner than in the adult, the ureteral orifices are relatively large, and the valvular mechanism cannot be accomplished with as great ease as in the adult; consequently, a retention of the urine in the bladder and ureters may easily result, and finally from back pressure dilatation of the renal pelvis is brought about.

Far more frequently than stenosis or atresia of the urethra, ureteral anomalies result in dilatation of the renal pelvis followed by all its consequences, and may be unilateral or bilateral. The fact that, in all likelihood, every case of primary hydronephrosis is the result of some congenital defect in the excretory urinary tract, renders it apparent that a hydronephrosis may occur in both kidneys quite as frequently as in one. In the first place, we may find a stenosis of the ureter or some abnormal position, such as torsion or kinks, or a malinsertion of the ureter into the renal pelvis, which results in the well-known valve formations. Then we may have two ureters, all of which may produce retention of the urine with its accompanying dilatation of the renal pelvis.

Relative to atresia of the ureter, a unique case has been put on record by Hensch. In a child six weeks of age a bilateral hydronephrosis was found which was the result of a complete cicatricial closure of both ureters. It is evident that the occlusion was not complete, because the infant voided urine up to the sixth week of life, so that it was assumed that, since the parenchyma of the right kidney was more markedly atrophic than the left one, the closure of the right ureter and the hydronephrosis on the same side was congenital, and as a result of the compensation hyper-

trophy of the left kidney, its pelvis became the seat of an inflammatory process which caused occlusion of the left ureter, followed by a secondary hydronephrosis.

Foerster has related a case where there was atresia of the rectum and in the place of the left ureter there was a solid cord which ran from a hydronephrotic kidney to the bladder. In this case the obliteration of the ureter can be most probably accounted for by some developmental disturbance and not from an inflammatory process, which may be assumed on account of the presence of another malformation, consisting of a rectal atresia. In a child eighteen months old Gruneberg found a complete occlusion of the ureter at its vesical end which had given rise to a hydronephrosis on the right side.

That partial obstruction of the ureters may give rise to the same results as when this is complete is made evident by three cases of primary hydronephrosis reported by Sudeck; in two a ureteral stricture was found at the renal pelvis end of the duct, and in the third at its entrance into the bladder.

It is still a much discussed question as to how the partial or total atresia of the ureter can be explained by the theory of intra-uterine or postfetal inflammation, resulting in the interference in the development, or by other processes. For example, Klebs believes that this may result in slight adhesion of the epithelial surfaces, which in the embryonal stage come into contact with each other.

English, who has undertaken a large number of careful investigations to ascertain the causes of stenosis and atresia of the ureter, concludes that there are three points of narrowing in the normal ureter, namely, where the canal leaves the renal pelvis, at some distance below this point, and where the ureter passes through the bladder wall. In later writings he compares the occlusions with these normally narrowed points, and finds that there is a surprising sameness of occurrence in the localization of these strictures, particularly when the obliteration is partial. Out of 65 ureteral strictures he found that the process only occurred in three instances in the middle of the ureter, while in 34 others it was present at the upper, and in 28 in the lower end of the ureter. From these facts he concludes that a pathologic stenosis is the result of some disturbance in the development of the physiological narrowings of the ureter.

Several cases have been reported of anomalies in the development of the ureters where there were two ureters, but here the hydronephrosis was only partial.

Wrary has recorded two cases of partial hydronephrosis with a double ureter. In the first one, the enlarged right kidney possessed two pelves, each with its own ureter, and only one of the pelves was dilated. Its ureter opened into the fundus of the bladder opposite to the vesical orifice of its fellow ureter, and where it entered the bladder it was surrounded by two folds, which, in all probability, caused obstruction to the free flow of the urine. The other ureter and renal pelvis on the same side were quite normal. In the second case, the left kidney had three pelves each with its own ureter. The ureters of the two lower pelves united soon after leaving them and showed no anomalous condition; but at the entrance into the bladder of the third ureter a sac formed by two layers of mucous membrane was found which had caused a dilatation of this ureter and its renal pelvis.

In a newly-born girl Osterloh found a double ureter running from the left kidney, the upper one entering behind the bladder into a blind sac, which had caused dilatation of the ureter and its corresponding renal pelvis. Lilienfeld has also recorded a case of double ureter running off from the right kidney; one was perfectly normal, while the second was represented by a diverticulum near its entrance into the bladder. The upper end was also obliterated, and as a result of a hydronephrosis the corresponding portion of the kidney had become destroyed. Zaluski has reported a similar case where one of two ureters belonging to the right kidney had a stenosis and its corresponding renal pelvis was much enlarged.

These cases which are taken haphazard from the literature demonstrate that such a partial hydronephrosis, which is not apt to be found where the kidney has a single ureter, can be traced to two principal conditions, namely, to the deeper opening of one ureter into the bladder, and secondly to the formation of a diverticulum at its vesical entrance. Why the former condition leads to a hydronephrosis and how the development of the diverticulum occurs, English has attempted to explain as follows: when the opening of the ureter into the bladder is too deep, its orifice sags in the region of the vesical sphincter, because the ureter must of necessity penetrate a thicker bladder wall. Consequently, when micturition takes place, compression of the ureter occurs from contraction of the fibres of the detrusor urinæ which results in a closure of that

portion of the ureter lying above its vesical orifice. From this there results a retention of urine in the ureter, followed by dilatation of the renal pelvis from back pressure.

As to the formation of a diverticulum, English assumes that in these cases that portion of the ureter lying immediately below the vesical mucosa is wider than that lying in the muscular layer and opens into the bladder by a very narrow orifice in most cases. Thus an obstruction is formed, a distention of the mucous membrane of the ureter situated in the muscular layer of the bladder takes place, which offers only slight resistance, and in this way a vesical diverticulum results.

A peculiar type of hydronephrosis, a so-called intermittent form, characterized by an occasional increase in size of the renal region, is occasionally met with when the ureter becomes kinked. The alternating increase and decrease in size of the renal region is the result of an alternating filling and emptying of the renal pelvis. When the renal pelvis has reached a certain degree of distention, the kink in the ureter is overcome by intrapelvic distention and the urine is discharged through the ureter. Landau has endeavored to explain how an intermittent hydronephrosis finally becomes a permanent one. The urine becomes retained in the renal pelvis when the patient is in an upright position and cannot be eliminated until the bending has been done away with. When this has occurred from pressure of the urine in the overdistended pelvis, the kinking again soon occurs and the renal pelvis again becomes filled. If this process of filling and emptying of the renal pelvis is frequently repeated, the elasticity of the latter becomes affected and more and more urine will be retained, so that, finally, the renal pelvis is so greatly dilated that it involves the ureter. The discharge of urine in the upright position then becomes impossible, and when the patient is lying down it can only occur when the kink in the ureter has been undone, which frequently does not take place. These kinks in the ureter are in many cases a secondary affair, particularly in those cases where they result from a movable kidney, but sometimes they are primary, as the following examples illustrate.

In a male who had been ill with symptoms of hemorrhagic nephritis, Weigert found the right kidney transformed into a cyst the size of a child's head, its walls measuring about 2 mm. thick. From the inner and lower portion of the cyst the ureter passed along the lower surface and then suddenly became bent at a right angle and passed downwards to the bladder, its lumen progressively diminishing. As there was no inflammatory change where the bend occurred, the latter was considered as a congenital defect. Roberts has recorded the case of a male, twenty years of age, who presented symptoms of intermittent hydronephrosis and finally died from uræmia. Both kidneys were found transformed into a sac filled with urinous fluid. The left ureter was stenosed near its upper orifice and entered the renal pelvis at a right angle, so that only forcible pressure on the tumor could produce a straightening out of the ureter and allow the urine to flow through. The right kidney, which was represented by a cyst, possessed two arteries, one lying over the other and coming from the aorta. The upper one, after supplying the suprarenal artery, went to the upper portion of the hilum of the kidney, while the lower one soon after its origin divided into two branches, one of which passed to the hilum and the other downwards to the perirenal fat and crossed the ureter near its upper extremity. The cause of the hydronephrosis of the left kidney was due to a stenosis and bend of the ureter, whereas, on the right side, compression of the ureter by a supernumerary renal artery caused the dilatation of the renal pelvis. As this case teaches, it may happen, although infrequently, that a supernumerary artery may produce hydronephrosis by compression of the ureter. I am only aware of two other similar instances. In one case reported by Küssmaul, the lower of the two arteries crossed the ureter at its point of exit from the renal pelvis and produced a fair amount of compression which resulted in a hydronephrosis. In the second case, reported by Rokitanski, the compression was caused by the renal artery at the upper extremity of the renal hilum, the vessel descending into the lower portion and crossing the ureter, and by compression of the latter hydronephrosis resulted.

Most peculiar are those cases where the ureter is patent and still a hydronephrosis is present. Such cases are occasionally met with, and in all of them a valvular obstruction has been found produced by a fold of the mucosa. Mendelsohn has attempted to explain as a reason for the formation of these valves, an abnormal insertion of the ureter into the renal pelvis, believing that the insertion takes place too high up. As a result of this high attachment, he points out that a portion of the renal pelvis under the point of attachment of the ureter must first become filled with urine before it can make its exit through the ureteral orifice. Consequently, dilatation of the renal pelvis results. By constant filling up of the renal pelvis

it becomes pressed against the ureteral walls by the gravity and pressure of the collected urine, thus forming an additional obstruction for the exit of the urine, in other words the mechanism is entirely a valvular one. Pathologists have looked upon this valve formation as congenital and not a secondary process, and as resulting from congenital developmental anomalies. They have been considered as a malformation whose development, according to Klebs's opinion, probably may be looked for at the point of exit of the ureter from the renal pelvis. Küster accounts for the development of these valves by an inflammatory swelling of the mucosa of the renal pelvis, while Simon believes that they must be looked upon as a result and not the cause of the hydronephrosis. He found at autopsy another obstruction in the ureter, which he considered the primary cause of the hydronephrosis, and believes that the development of the valves results from a twist which the kidney undergoes as a result of the distention of its pelvis, so that the pelvic end of the ureter becomes displaced.

Ayrer reports such a case of hydronephrosis, the cause of which was a valve formation in the ureter. The patient, eighteen years old, presented a kidney which had become transformed into a sac, its walls varying from 2 to 3 mm. in thickness and containing about 7 litres of a thick yellow fluid. At the point where the ureter opened into the cyst there was a duplication of the mucous membrane, which protruded into the lumen of the ureter like a valve. There was a kind of bend of the ureter causing a lateral displacement, which was produced by a band of connective tissue accompanying the ureter from its origin to a point about 1.5 cm. below the cyst. Ayrer believed that the latter was the cause of the valve formation. In a female forty years of age in whom a diagnosis of ovarian tumor had been made, Wölfler discovered at operation a hydronephrosis, which was found to be produced by a pocket formed in the cyst wall at a point where the ureter entered into the pelvis and formed a crescentic valve. He also examined the ureters of 100 infants and found, in 20 per cent., at a small distance from the opening of the ureter into the renal pelvis, from one to several folds in the mucous membrane, varying in size from 1 to 5 mm., and he consequently thought that a valve could be formed by adhesion of two such folds. A labiate opening of the right ureter into the renal pelvis had produced a hydronephrosis in a case recorded by Giraud, as no other cause for the production of the latter could be found. Reclus has described a case of bilateral hydronephrosis, in which the ureter on the left side up to the bladder was permeable, presenting no bend or other malformation, while,

on the right side, only a few fibrous bands were found which had caused compression and dilatation of the ureter. The bladder and urethra presented no defect. Bernard, in four cases of hydronephrosis in nursing infants, found uric acid sand as the only cause for the lesion and is of the opinion that this may explain the pathology of the development of many cases of hydronephrosis where the cause is vague.

Edes reports several such instances of hydronephrosis, followed by atrophy of the kidney, in children in whom not the slightest obstruction to the flow of urine could be found. In these children during life involuntary micturition occurred, while postmortem showed hypertrophy of the bladder walls and other signs of cystitis. He also found several other examples recorded by others, and he believed that, in these cases, as a result of frequent contraction of the bladder produced by cystitis, a back pressure took place which brought about dilatation of the ureter and renal pelvis.

Levin and Goldschmidt, in a very interesting contribution published in 1893, in *Virchow's Archive*, entitled "Versuche über die Beziehungen zwischen Blase, Harnleiter und Nierenbecken," on the strength of several successful experiments in rabbits, assumed that these forms of hydronephrosis in which no obstruction to excretion can be found may be attributed to a return flow of urine from the bladder into the ureter and from here to the kidney pelvis. Up to the time of their studies, it had been supposed that as a result of the oblique opening of the ureter into the bladder, a return flow of urine into the ureter was an impossibility, but these writers have proven experimentally, both by injections of fluid into the bladder and by artificial retention of urine by ligation of the urethra, that an acute reflux of the contents of the bladder can easily be produced. This reflux rushes rapidly into the renal pelvis, at first paralyzing its contractility from the great dilatation of the ureter, and at length produces the most varied abnormal movements of the ureter with the renal pelvis, such as antiperistaltic and spasmodic contractions. This result of their experiments led them to the explanation of cases of hydronephrosis which were produced by an irritation of the kidney, with a constant desire to empty the renal pelvis so that hypertrophy finally results and afterwards dilatation, a theory which would appear to be verified by the cases reported by Edes. On account of the permanent contraction of the bladder and ureter, these authors furthermore concluded that the renal pelvis became filled with urine and from this circumstance became distended.

If we now sum up the causative factors of primary hydronephrosis, one must place at the head of the list certain anomalies of the ureter, and secondly others occurring in the remaining portions of the urinary tract, such as the bladder, prostate, and urethra, which are usually developed during intra-uterine life and, consequently, it may be assumed that all primary hydronephroses have a congenital origin. It is quite true that

English claims that the obstruction in the ureter, such as found in adults, is never present to the same extent at birth, but that, on the contrary, certain changes take place in them from which occlusion results. However, the type of obstruction is probably the same at birth, only it is necessary that other factors should intervene to cause retention of the urine, otherwise it would be impossible to understand why in one case these anomalies should result in a hydronephrosis, while in other cases a perfectly normal kidney is found, although these anomalies are present in some portion of the urinary tract.

RECENT DEVELOPMENTS IN PYELOGRAPHY.*

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PYELOGRAPHY is not a new subject. The idea of injecting a substance which is impenetrable to the Röntgen ray into different parts of the urinary tract has for a long time been suggested by various observers.

To Professor Voelcker of Heidelberg must be given the credit of first demonstrating a radiogram of an injected renal pelvis in the living, and of calling attention to some of the possibilities of the method. For some reason the method did not arouse any general interest and nothing more was heard from it until within the last year or two.

So far as I have observed, the plates which had been published at the time I commenced my investigations almost two years ago showed no other condition than that of the normal pelvis and hydronephrosis. In a paper read before the United States Clinical Surgical Society last October and published in the *ANNALS OF SURGERY* for April, 1910, I was able to demonstrate plates showing a variety of conditions in the urinary tract, bringing out various associated data. Recognizing the practical value of the method, we have since employed it almost daily in St. Mary's Hospital. The illustrations for this article will be selected from several hundred collargol radiographs which we have made thus far.

Technic.—Following Professor Voelcker's suggestion, we have used collargol as the injected medium in most of our figures. The silver salt casts a definite shadow, and furthermore has the advantage that it can be used in weak solutions. A solution as low as 2 per cent. will often outline the renal pelvis quite clearly, and it can be injected without fear of harmful results. That it is a non-irritant is shown by its well-

* Read before the American Urological Society, June, 1910.

known use in intravenous injections. At operations we have repeatedly found collargol retained in the renal pelvis into which it had been injected several weeks before. It seldom causes more than a slight temporary irritation when injected. It does not interfere with primary union in operation wounds. Ordinarily we use a 10 or 15 per cent. solution, although a 5 per cent. solution suffices to cast a fair shadow. The stronger solutions generally cast a denser shadow, and retaining fluids in a dilated pelvis will often dilute even a 15 per cent. solution considerably. The amount injected will, of course, depend upon the size of the pelvis; a large hydronephrosis will contain several ounces without harm.

The Normal Pelvis.—As I have already stated, the normal pelvis will vary much in size and contour. In fact, in order to correctly interpret abnormality of the pelvic outline, one must become familiar with the wide range of pelvic contour. Marked colic, brought on by overdistention, will cause contraction of the normal pelvis and only a small slit will remain. As a rule a severe colic can be obviated by carefully injecting the fluid while the radiograph is being made. Without going more fully into the subject, I will show two extremes in the pelvic contour. Both were made in females with indefinite tumors in the right hypochondrium which, at operation, proved to be due to distended gall-bladder, while the kidneys were found normal.

Fig. 1 shows the slit-like pelvis in a normal kidney obtained immediately after injecting 3 c.c. of collargol, which caused a severe colic and which might easily be interpreted as the remnant of a pelvis encroached upon by surrounding tumor tissue.

Fig. 2 shows a large pelvis in a normal kidney with a content of 18 c.c. The pelvis, while of fair size, was not found abnormally large nor pathologic in any way. This is one of several figures which we have, showing a large normal pelvis containing from 15 to 25 c.c. collargol.

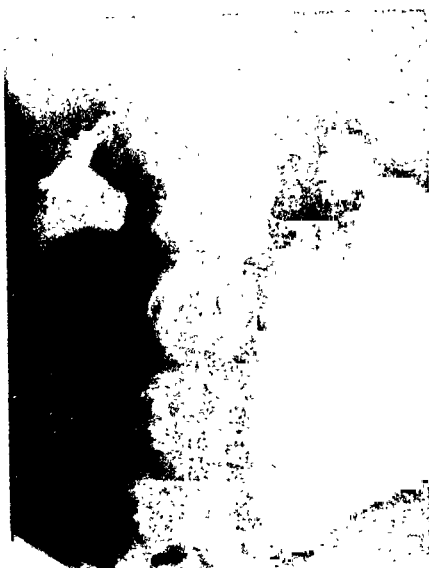
The Dilated Pelvis.—As before stated, the overdistention method, if correctly employed, is most accurate in determining

FIG. 1.



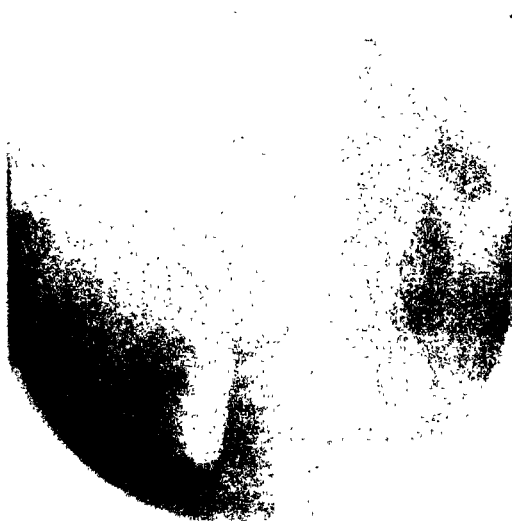
Normal pelvis in actual colic after
injecting 3 c.c.

FIG. 2.



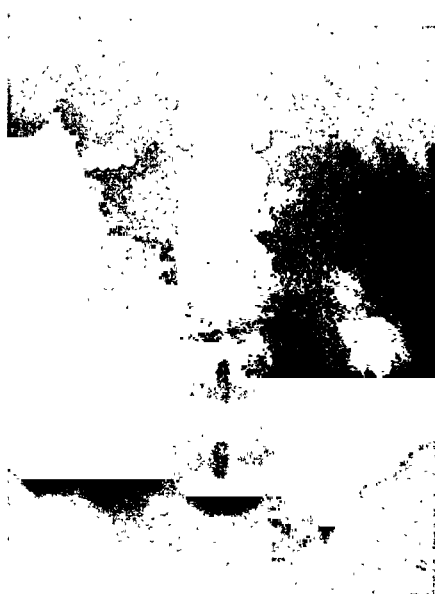
Normal pelvis with capacity of 18 c.c.

FIG. 3.



A moderate hydronephrosis largely within
the renal substance.

FIG. 4.



A moderate hydronephrosis largely within
the renal substance.

FIG. 5.



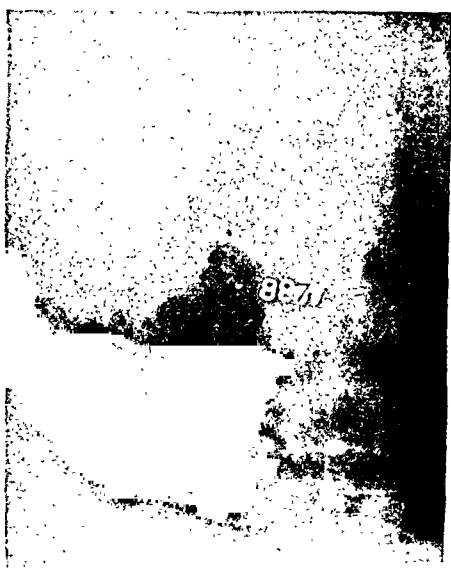
A retention or mechanical dilation of the renal pelvis.

FIG. 6.



An inflammatory dilation of the renal pelvis.

FIG. 7.



A combination of mechanical and inflammatory dilation.

FIG. 8.



The pelvis invaded by tumor tissue, showing but little space remaining.

FIG. 9.



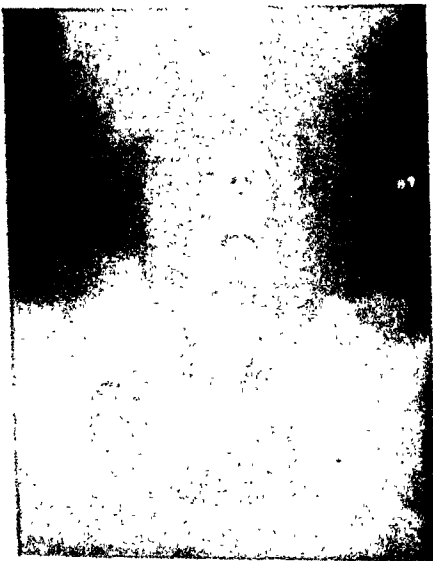
A and B, stones at the ureteropelvic juncture and in a lower calyx respectively. Also a retention hydronephrosis with but little functioning kidney.

FIG. 10.



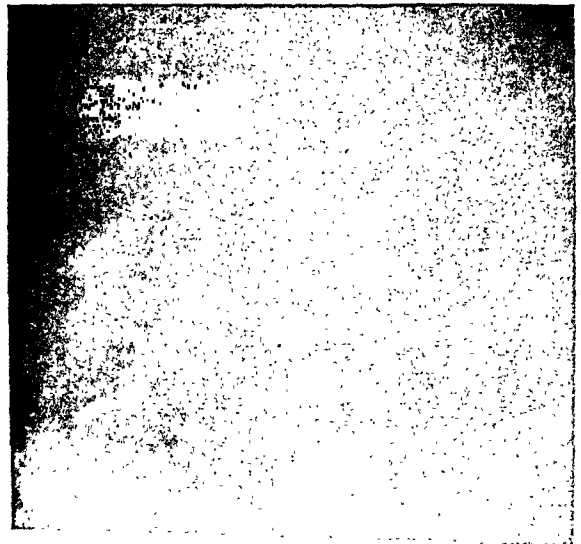
The upper shadow is that of a gall-stone; the lower that of a normal pelvis. The distance between identifies the former as extrarenal.

FIG. 11.



A hydroureter extending from the bladder to a hydronephrotic pelvis.

FIG. 12.



The irregular retracted pelvis occurring in a bilateral cystic kidney.

the existence and extent of a dilated pelvis, providing that the catheter is able to pass the etiological ureteral obstruction. However, it is always more satisfactory and of great confirmatory value, at least, to visibly demonstrate the dilatation. Furthermore, when the catheter meets an impassable obstruction, enough collargol can frequently be injected past the constriction to outline the pelvis enlargement quite definitely. Fig. 3 illustrates a moderate pelvis outlined under such conditions. With the overdistention method the condition could not be demonstrated because of the immediate return flow of most of the injected fluid. On the other hand, there are undoubtedly hydronephroses which will not appear as such in the injected radiograph. This is particularly true when the dilation is largely confined within the contour of the kidney, where for some reason the free pelvic wall did not yield. This is graphically illustrated in Fig. 4.

The etiological factors, mechanical or inflammatory, are usually quite clearly defined in the pelvic outline. The mechanical or retention dilation is marked by regularity,—the even lines of the pelvic wall and the rounded ends of the dilated calyces (Fig. 5). The inflammatory pelvis, on the other hand, is irregular in outline (Fig. 6) and often with detached shadows caused by cortical abscesses connected with the pelvis. Occasionally we will get a combination of both factors. In Fig. 7 we have illustrated a retention pelvis as the result of some peripelvic inflammatory process. The regular dilation of the calyces is varied by the rather irregular outline of the free pelvic wall.

Tumor Deformity.—On account of the wide variation of size and shape of the normal renopelvic outline, we must be careful in interpreting a pelvic outline as pathologic. As previously stated, deformity of the renal pelvis caused by tumor will result from retraction of its whole or part of the tumor tissue, or from encroachment of the tumor in the pelvic space. Wilson¹ has demonstrated that in most renal neoplasms

¹ Wilson: Old Dominion Journal of Medicine and Surgery, No. 4, April, 1910.

a marked deformity of the renal pelvis is visible in a cross-section. In a previous paper I published two collargol plates showing this deformity prior to operation. Naturally the pelvic outline must vary widely from the normal in order to be recognized as a deformity. In case of tumor retraction the pelvis may be irregularly large, or a single calyx may be distended and retracted even three or four inches. Again the pelvis at the ureteropelvic juncture may be abnormally broad or square in outline. In case of tumor encroachment, but very little of the pelvic space must remain in order to be able to recognize actual deformity (possibly one or two thin streaks), or if the pelvic space is obliterated by the tumor, nothing would be visible except the collargol within the adjacent catheter. In Fig. 8 but two narrow shadows, one on either side of the encroaching tumor, show all that is left of the pelvis. Thin streaks spreading out into the kidney tissue may be all that is left of the retracted calyces. An interesting feature in such cases is, that injected collargol does not readily drain away, as can be demonstrated by radiography several days later, when shadows of the retained collargol will often be shown. Another point of corroborative value in suspected tumor of the kidney is to find the pelvis shoved over in unusual positions. In one of our figures it was found lying over the vertebral column. However, it will not be possible to make a radiographic demonstration of distinct pelvic deformity in every renal neoplasm. A large number, possibly a third of them, will not have enough deformity to be of diagnostic value. Again, because of obstruction to the ureteral catheter from various abnormalities in the course of the ureter, external pressure, or even ureteric metastasis, it will often be found impossible to reach the pelvis with the injected fluid. It has been our experience that in order to secure the best results, one should employ a fairly stiff catheter of as large a calibre as possible and radiograph while injecting the collargol.

Localization of Renal Shadows.—While it is true that with

good radiographic technic and apparatus, the kidney shadow can very often be fairly well outlined, nevertheless, for technical reasons in the course of routine examination, it will frequently happen that the renal outline is quite indefinite or will not show at all. Furthermore, distended gall-bladders, large abnormal livers, abdominal tumors, a large fatty capsule, etc., often obscure the kidney shadow and give misleading ideas of the exact outline and position. While it is very often possible to approximately localize renal stones in the kidney shadow if well defined, we have found that it can be done more accurately with the aid of collargol. A small stone deep in the calyx may, in the unaided radiograph, appear to be in the cortex, while in the collargol plate the cortical stone should usually be seen quite distinct from the pelvic shadow and its relative position in the parenchyma quite accurately ascertained. Pelvic stones will either be obscured entirely by the collargol shadow or show faintly through it. It is true that cortical stones just beyond a calyx may, in exceptional cases, appear to be continuous with the calyx shadow and in it. Furthermore, dilated ends of calyces may appear detached and may simulate cortical stones. Again, a stone in the lateral renal cortex in direct line with the pelvis might appear to be within the pelvis shadow, depending upon the comparative density of the stone and pelvic shadow. Such a lateral position is, however, rather infrequent. If any doubt exists, its position can be ascertained by making the radiograph at various angles. Another possible source of confusion may arise when extrarenal shadows are in direct line with the pelvis and may appear included within it. Nevertheless the stone can be definitely localized by means of the injected radiograph in most cases, which is of much aid to the operator (Fig. 9).

Differentiation of Extrarenal Shadows.—Although the extrarenal shadows can usually be identified as such, it is sometimes difficult to do so. The relation of the injected renal pelvis to a neighboring shadow is often an aid to its identification. This is particularly true in the differentiation of gall-

stone shadows. With the development of radiographic technic, gall-stone shadows are being found more frequently. Peculiarities in the shadow will often assist in identifying them. When in a normal position, the distance between the gall-stone shadow and the injected renal pelvis should usually identify them as being extrarenal (Fig. 10). However, when the gall-bladder lies low and overlaps the kidney area, gall-stone shadows appear to be intrarenal, but peculiarities in their relation to the injected pelvis, together with cystoscopic data, should suffice to identify them in most instances. We have been endeavoring recently to employ stereoscopic collargol radiographs in their differentiation.

Ureteral Obstruction.—Obstruction to the ureteral catheter may be physiological and difficult to differentiate clinically from the pathological. An actual obstruction which occludes enough of the ureteral lumen to hinder the passage of the catheter usually causes enough urinary retention to produce more or less dilation of the renal pelvis and ureter above. This can be demonstrated frequently in a collargol radiograph. The method is particularly available in the diagnosis of ureteral stone, which, even with the best technic, will occasionally be missed by the radiograph. At times the obstruction is such that not even enough of the injected medium can pass to cast a shadow. More often, however, enough can be forced by to outline the dilated ureter and pelvis above, even though the catheter itself is blocked. Should the catheter pass the obstruction, in order to demonstrate the ureteral dilation, it is advisable to withdraw the catheter almost to the obstruction and then inject. We have several plates where ureteral dilation involves but a part of the ureter above the obstruction. Again, another plate shows but little dilation of the ureter above the obstruction, but considerable dilation of the pelvis. A peculiarity of low-lying ureteral obstruction, and particularly with long-standing or congenital obstruction, is frequently noted in that the first part of the ureter, extending from the ureteropelvic juncture to the first point of narrowing, will often remain undilated even though the remainder of

the ureter is much distended (Fig. 11). Because of the difficulty of fully distending a dilated ureter, it may be impossible to outline the full extent of the dilatation. With extreme ureteral dilatation one should first endeavor to partially drain the ureteral contents and then inject a heavy solution of collargol. Profuse return flow alongside the catheter in a naturally flaccid ureter may give the appearance of a moderate dilatation.

Solitary Kidney.—The pelvic outline in solitary kidney may be of diagnostic value. In a plate already published, I demonstrated the pelvis of a congenital solitary kidney. The pelvis was shown to be about twice the usual size but with normal appearing calyces. On exploration the actual size of the pelvis was found to be commensurate with the hypertrophied renal parenchyma. An acquired solitary kidney, on the other hand, when the other kidney becomes functionless, will show a pelvis normal in size and contour. The parenchyma may be double its normal size, but the pelvis remains as it was before. It may be noted with interest that neither of the two cases showed any untoward symptoms following the pelvic distention.

Renal Tuberculosis.—It often happens that a non-tuberculous pyelitis occurs with clinical symptoms, *i.e.*, bladder ulcerations and unilateral cloudy urine, all suggestive of renal tuberculosis. Again, it may happen that a renal tuberculosis infects the bladder mucosa but little, and the clinical and cystoscopic picture may resemble a local pyelitis. It is peculiarly true that a pyelitis will often show a moderate pelvic dilation in the collargol plate. On the other hand, with renal tuberculosis a cortical abscess or an irregular pelvis and an inflammatory pyonephrosis may often be outlined and of distinct value in differential diagnosis.

Cystic Kidney.—In Fig. 12 we were able to demonstrate the pelvis of a cystic kidney. A clinical diagnosis of unilateral renal tumor was evident. The pelvic outline is similar to that usually found in inflammatory pyonephrosis. The catheterized urine being clear, pyonephrosis was excluded. Diagnosis of a malignant renal tumor could hardly be made from the figure

because, (1) a pelvis of such proportions would be the result of a secondary degeneration and that such is not the case is proven by the clear urine; (2) the outline of a pelvis accompanying secondary degeneration in the malignant renal tumor would be quite different. The irregularly enlarged pelvis was found at operation to be due to retraction of a cortex resulting from diffuse cystic changes.

Congenital Malformations.—The frequency with which fused kidneys and median lying kidneys are found at operation should keep us on the lookout for them clinically. The position of a styletted catheter, as suggested by Kollischer and Schmidt, would usually suffice to determine anomalous positions in a radiograph. However, the size and shape of the pelves as well as that of the ureters can be outlined in addition to locating them by the injected radiogram. We found a very interesting condition in a plate recently; a moderately hydronephrotic pelvis was seen lying across and to the right of the second lumbar vertebra, with a dilated tortuous ureter leading to the left base of the bladder. The right renal pelvis and ureter were found to be normal in position and size. The plate, which was made stereoscopic, made the lower pelvis appear at a level much more anterior to the right and uppermost pelvis. An interpretation of the plate was rather difficult. We knew that we were dealing with a small hydronephrosis and obstructed ureter, but whether this occurred in a congenital pelvic kidney or in a fused kidney, we could not determine. Judging from the distance between the two pelves and the fact that the lower pelvis lay so far anterior to the upper one, we inferred the existence of two separate kidneys as the more probable. At operation a fused kidney seven or eight inches in length was found. It had three distinct pelves. The two upper were normal and connected with the ureters which fused above the bladder. The lowest pelvis was found to be hydronephrotic, as demonstrated in the plate, and with a dilated tortuous ureter.

Stereoscopic Radiographs.—We have recently made stereoscopic collargol radiographs which promise to give in-

teresting data. They should be of practical value in the demonstration of shadows at different levels from the injected pelvis. This should be particularly true in the differential diagnosis of overlying gall-stone shadows. Unfortunately, the shadows cast by the organs surrounding the kidney are usually too dim to be of much differential value in the stereoscope.

We have therefore proven quite conclusively that radiograph and cystoscope, working together, make it possible to demonstrate many conditions which either would fail to demonstrate alone. We have frequently found the injected radiograph to be of considerable practical value in demonstrating the following conditions: (1) normal pelvis; (2) hydronephrosis; (3) pyonephrosis; (4) pyelitis; (5) renal tuberculosis; (6) renal tumors; (7) abdominal tumor differentiation; (8) horseshoe and median lying kidneys; (9) solitary kidney (unsymmetrical); (10) cystic kidney; (11) differentiation of extrarenal shadows; (12) localization of renal shadows; (13) aid to ascertain renal functional capacity; (14) identification of ureteral obstruction; (15) hydro-ureter.

NOTE ON THE REMOVAL OF CARCINOMA OF THE FUNDUS OF THE URINARY BLADDER.

BY FRANCIS R. HAGNER, M.D.,

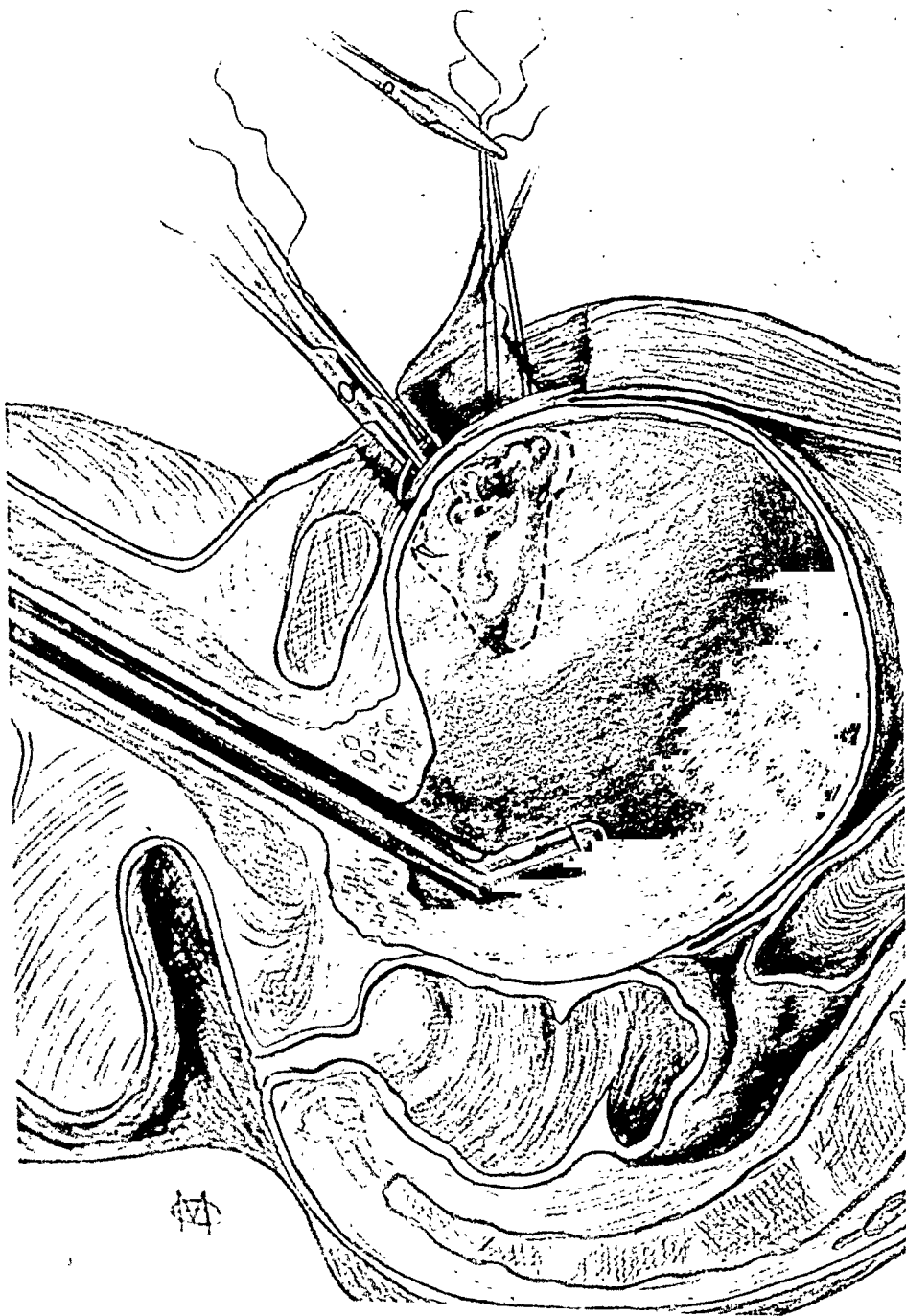
OF WASHINGTON, D. C.,

Professor of Genito-Urinary Surgery in the George Washington University.

THE fundus of the bladder is a comparatively rare location for new growths, the more common seat being the base.

It has been my fortune to have two cases of carcinoma of the fundus of the bladder under my care during the last few months, both operable. My inability to remove the friable tumor in the first case without breaking the tumor mass suggested to me the method of removal that was resorted to in the second case. By the *old* method of procedure (which was followed in the first case) just as soon as the incision was carried through the bladder wall this viscus collapsed, thereby making it impossible to determine the location for my incision on the other side of the tumor without introducing fingers into the bladder. The manipulation of the tissues by the fingers, necessary to determine lines of incision, caused a crumbling and breaking off of many small portions of the neoplasm. I believe it is generally conceded that one of the weakest features of the operative treatment of new growths of the bladder is the production of trauma to the tumor mass during its removal. It is possible, with proper care exercised, to remove tumors from the fundus and lateral walls of the bladder without the slightest traumatism to the tumor mass by the method I will describe. The operation is impracticable for tumors of the bladder *base*, which, unfortunately, is the most common situation for the growths. The following is the report of the case and description of the operation.

Male, white, forty-three years of age, was referred to me by Dr. Shaw, on March 15, 1910. Eight months ago patient began passing dark soft solid masses of tissue in his



Showing use of sutures to outline bladder tumor.

urine. From two to three days before the passage of the masses the urine would become coffee colored, but after the passage it would clear and become normal. He has passed these pieces of tissue five times during the past eight months. He had no frequency of urination or bladder pain. On his first visit he brought the last piece of tissue he had passed. This appeared to be gangrenous epithelial tissue. The man was well nourished and otherwise apparently healthy. His prostate and seminal vesicles were normal. Cystoscopic examination March 17, 1910, at Garfield Hospital, showed a bladder capacity of 350 c.c., a normal bladder mucosa except to the right of fundus, where a partially ulcerated growth, 5 c.c. in diameter, was noted, covered with black necrotic tissue. The mucous membrane was raised in several areas around the base, showing infiltration of the bladder wall by the new growth. A diagnosis of carcinoma of the anterior and right lateral wall of the bladder was made. Patient was operated on March 19.

The following is a description of the operation employed: The bladder was irrigated, and on account of bleeding, adrenalin 1:10,000 was instilled and allowed to remain five minutes. The bladder was then distended with 350 c.c. of salt solution, and a Nitze cystoscope was introduced. This was held in place by an assistant, while a suprapubic incision down to the bladder wall was made. The prevesical fat was well separated and the tissues well retracted by wide lateral retractors so as to give a good exposure of the bladder wall. The growth was then inspected through the cystoscope, the right hand holding the cystoscope; with the left, a needle was pressed on the fundus of the bladder, and the dimpling caused thereby was readily seen through the cystoscope. The needle was carried first to the left of the growth at a sufficient distance to give a margin of healthy bladder wall, it was then plunged into the bladder, being held in place by an assistant. The same procedure was carried out at the right of the growth and at the lower border. An attempt to place a needle above would have penetrated the parietal peritoneum, as this was involved in the growth. A sharp knife was now carried to the outer side of the three needles placed around the growth, the portion of the bladder wall to be removed being clamped at its cut edge as soon as the incision was started. The bladder wall containing the growth was lifted up by the clamp and held

by an assistant. The fluid left in the bladder was removed by a large syringe through the suprapubic wound to prevent its entrance into the peritoneal cavity. The incision in the bladder wall was then carried upwards into the peritoneal cavity and a portion of parietal peritoneum covering the growth was removed. The bladder and peritoneal wounds were then closed by two rows of sutures, a suprapubic drain being left in the bladder.

As far as I am able to learn, this method of attacking these growths has not been tried before. As I have stated, the operation is only applicable to growths in the fundus and lateral walls, but even when the growth is near the base it may be possible to get one or two points to guide us in the incision so as to prevent the traumatism to the growth by handling. I believe it is better to use sutures to fix the points of incision in preference to the needles I employed, as there is a slight leakage of fluid around the needles that lets the bladder wall relax and makes the introduction of the last needle difficult. On the other hand, a threaded needle can be seen with the cystoscope when it enters the bladder, and the location of the suture when in place can be readily noted if slight tension on it be made, so as to cause a stretching outward of the bladder wall at the point of suture. This tension also prevents leakage of fluid and facilitates the introduction of the other suture by preventing the slight collapsing of the bladder wall.

The patient on whom this operation was performed has made a good recovery and is apparently in good health. Of course it is too early to express any opinion as to the ultimate result in this case, but we do know that the tumor was removed without the slightest traumatism to the growth—not even the necrotic tissue present was disturbed.

INTRAPERITONEAL CYSTOTOMY.

BY CHAUNCEY E. TENNANT, M.D.,

OF DENVER, COL.

SURGICAL progress has always been subservient to tradition. This is as it should be, for only by careful consideration of past experience has it been possible to maintain surgical procedure on a safe and sound basis. It is this same tradition which is, no doubt, responsible for the present hesitancy in attacking the urinary bladder through the peritoneal cavity.

The possibilities and advantages of this route were successfully worked out and recommended by Harrington in 1893.¹ Since this admirable report, little or nothing appears in the surgical literature regarding this method of cystotomy, until an article by Charles H. Mayo in the July number of *ANNALS OF SURGERY*, 1908, entitled "Transperitoneal Removal of Tumors of the Bladder." Following this, two more contributions have been made to American literature regarding the method and technic, and report of cases. These are by Scudder and Davis, in the *ANNALS OF SURGERY*, vol. xlviii, December, 1908, and E. S. Judd, in the *Journal A. M. A.*, vol. liii, December 25, 1909.

Long before Harrington pointed out the possibility of successful transperitoneal cystotomy, it was known that a normal urine was practically sterile.² It was also a well-known fact that punctures and accidental injuries to the ureters and bladder, occurring during operations, readily healed when properly repaired. In the face of all this, the persistent effort to avoid the intraperitoneal invasion of the bladder can only be attributed to a certain close adherence to time-honored traditions.

Why these should have retarded the development of urinary surgery more than other fields is difficult to explain, for the suprapubic and perineal muscle splitting operations, which have always been the recognized course of procedure,

are attended with a high mortality, and sometimes the permanent discomfort of a urinary fistula.

While it has long been recognized that urinary infiltration into the muscle planes produced early and profound absorptive symptoms, and even fatal toxæmias, it has also been known that the peritoneal cavity better tolerated this same urine. But in spite of all this, there has been a persistent choice of the route through the muscle planes to the bladder, neglecting the rapid healing, tolerant, and effectual peritoneal route.

Harrington, in his first report, said: "Intraperitoneal cystotomy may be performed for tumors of the bladder, for enlarged prostate, for disease of the ureters, for cases of large stone in the bladder, and for sacculated stone; there are advantages in the operation which, certainly at times, render it preferable to suprapubic cystotomy."

Watson in a comprehensive report, "The Operative Treatment of Tumors of the Bladder,"³ which covers records of 643 cases, says: "That 28.6 per cent. of benign and 46 per cent. of carcinomatous growths of the bladder have been surgical failures."

This is, of course, by the use of the muscle splitting suprapubic and perineal routes. In this same report Watson also shows that by the suprapubic route papillomata have been removed with 20 per cent. mortality, carcinoma with 28 per cent., and sarcoma 63 per cent., early recurrence following in both the benign and malignant forms in over 20 per cent. of the cases.

This high mortality is no doubt partially due to the urinary absorption through the severed muscle planes; also to the ineffectual means of reaching the tumor. The frequent recurrence is no doubt due to the incomplete removal of the mass and its adjacent tissue.

Dr. Charles Mayo in his report on "Transperitoneal Removal of Tumors of the Bladder" in the July ANNALS OF SURGERY, 1908, says:

"We have not been satisfied with the ordinary suprapubic incision in operating upon large tumors of the bladder."

According to Judd,⁴ 90 per cent. of the tumors of the bladder begin in the base, consequently with the suprapubic and perineal incisions, it is impossible to secure good exposure or do a radical operation, and he further adds: "after closing the suprapubic incision in the bladder, we (the Mayos) have occasionally had the wound open and the urine drain for some time through this opening, *but in no instance has there been leakage from the incision through the peritoneal surface, which is no doubt owing to the firmer and more rapid healing of the peritoneum.*"

Statistical and clinical observation therefore indicate that intraperitoneal cystotomy should be more frequently the method of choice, and often it is the only method which can give any reasonable promise of permanent relief.

The more recent literature reports the successful use of the transperitoneal route for vesical tumors, especially where thorough inspection or removal of the bladder wall is deemed necessary. The mortality from this work appears to be decidedly less than with the muscle splitting operation, to say nothing of the security that comes with the knowledge of immediate bladder closure, and the comfort of the patient and nurses, while it also affords the best possible visual and operative access to all parts of the bladder.

Contrary to what one might naturally expect, the free opening of the bladder into the peritoneal cavity is not attended with a copious and annoying overflow of urine into the operative field. Somewhere in the recent literature I have seen the statement made that when an anæsthetized patient is placed in the Trendelenburg position (which is necessary in the transperitoneal cystotomy), there is practically little or no urine secreted, and this has seemed to be true in the cases I have operated by this method.

While I do not mean to advocate transperitoneal cystotomy in any but selected cases, I am sure that more successful results in bladder work may be accomplished, with considerably less mortality and much greater comfort to the patient, by the intraperitoneal route.

The method of operation, as first recommended by Harrington, and later endorsed by Charles Mayo, Scudder, and Judd, is practically the same. The patient is placed in the Trendelenburg position, and a long median incision is made from the umbilicus to the symphysis pubis. The muscle planes, through which the incision has been made, and the abdominal viscera are packed out of the way, and the superior external angles of the bladder picked up and brought forward. An incision is made in the superior and posterior surface, the urine mopped out, and the incision continued down the posterior surface as far as deemed necessary. Two anchoring sutures may then be introduced through the bladder wall to spread the borders of the incision, when a full view of the inside of the bladder is obtained. Tumors may then be outlined, their relation and extent determined, and radical operations done for their removal.

Large sections of the bladder wall may be excised and the ureters transplanted with apparently no greater mortality than occurs in the ordinary ineffectual suprapubic operations.

Most authors recommend chromicized catgut through-and-through Connell suture, in closing the bladder, this to be followed by a peritoneal reinforcement with a linen Cushing suture.

I have used this method, and also plain catgut throughout, and now prefer the latter because of its certain and early absorption. Chromicized catgut may be more certain of holding the parts together, although I have found the knot (which should be made inside the bladder) discharge through the urethra five days after the operation.

A catheter may then be introduced into the bladder for continuous drainage, although some claim this is not necessary. I have been disposed to use the catheter for the first week following an intraperitoneal cystotomy. One certainly feels more secure with this safety-valve in place, and it offers but little added inconvenience to the patient, with no increased danger.

There is no need of testing the bladder for leakage, for if

the through-and-through sutures, are well placed, close together, and the peritoneal covering well overlapped, it is certain to be water-tight under normal pressure.

The parietal peritoneum is then closed as usual, and the muscle sheaths united as in any other abdominal operation, excepting, however, in the writer's experience, the introduction of a small drainage tube down to the peritoneum for the first forty-eight hours. This procedure will save a possible postoperative abscess in the muscle planes, which is prone to occur where bacteriuria is present. If one has been careful to protect the edges of the abdominal incision, and feels absolutely certain there has been no infection, this last step may not be necessary, although it is advisable, as it affords escape for any urine left in the incision after the operation.

In two recent cases which I shall briefly report, I learned that it was possible to perform an intraperitoneal cystotomy in the presence of a very marked cystitis, although I do not wish to be understood as recommending this procedure without some very good reason for so doing. Both of these cases had a cloudy alkaline urine with pus, colon bacillus, and other pyogenic micro-organisms, but after careful consideration, it seemed best to use the transperitoneal route. Both cases were operated, the bladder immediately closed, and successful results secured, sparing both the patients and myself the annoyance and apprehension of a urinary fistula.

CASE I.—Mr. P., age fifty-five, had hæmaturia for the past year, first at irregular intervals, then free and constant, with urinary obstruction due to large blood-clots. Patient lost considerably in weight; also much sleep, owing to frequent nocturnal micturition. Digital examination of the bladder through the rectum disclosed a horned-shape mass extending upwards and into the bladder from the upper border of the prostate gland. This tumor, although hard, seemed to involve the muscular coat. It was very difficult to use the cystoscope, owing to the great amount of bleeding, which frequent washing would not eliminate. However, a fair view was obtained of the upper surface of the mass, a deep ulcer appearing at the very apex.

The urine contained pus and blood, with a specific gravity of 1020, acid reaction, and a marked bacteriuria—colon bacillus and staphylococcus.

Removal by the transperitoneal method, following the technic as above described, was effected. A thorough removal of a hard indurated mass was accomplished, together with the prostate and a considerable portion of the mucous membrane. The bladder and abdominal incisions were completely closed, a catheter inserted in the urethra, and the bladder washed out once daily for the first week. There was no rise in temperature, no infection, and perfect repair, patient being discharged in two weeks.

CASE II.—Mr. W, age twenty-one. After fall on perineum one year ago, developed frequent urination with dysuria. More recently has had frequent chills and temperature, loss of weight and sleep, and is compelled to wear a rubber urinal both night and day. Examination with the finger in the rectum discloses a large mass about the right prostatic lobe, which is extremely tender. The urine is strongly alkaline, cloudy, foul odor, full of pus, and loaded with colon bacilli and diplococci. Sounds failed to disclose anything suggesting stone. While the use of the cystoscope provoked much tenesmus, in spite of the local anæsthetic which had been used, a little perseverance brought the lower end of the bladder into full view, when all question as to the diagnosis was put at rest by the sight of a large irregular white mass, covered with slimy mucus, and apparently partially encysted in the bladder wall. About this mass, as far as could be seen, the bladder was thick, œdematous, and suggestive of some other hidden lesion. Operation being at once accepted, I decided to undertake the transperitoneal method because of the appearance of the bladder wall and the embedded stone.

After making the abdominal incision, I discovered a chronic catarrhal appendix and removed it. Then packing everything well away from the bladder site, I made a long incision on its superior and posterior surface, delivered the stone weighing 26.5 grammes, examined the bladder walls and the urethral outlet, closed the bladder, introduced a soft rubber urethral catheter and washed out the bladder once daily.

A rise of temperature on the third day gave warning of a subcutaneous stitch abscess, which necessitated the removal

of several of the retaining sutures and drainage down to the peritoneum. The infection readily yielded to this treatment, and the abdominal incision promptly closed. The catheter was removed the seventh day, and the patient was out of bed with good bladder function on the fourteenth day.

While these are the only two cases which I have operated by this method, neither of them suffered with troublesome urinary fistulas nor had a complication because of opening a septic bladder. I report them, not to encourage the intraperitoneal cystotomy in every bladder lesion, but to show that it is possible to use this method even in the face of marked bacteriuria.

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A CHART TO AID IN THE TREATMENT OF CYSTITIS BY DISTENTIONS OF THE BLADDER.

BY HOWARD A. KELLY, M.D.,

OF BALTIMORE, MD.

I do not think we yet fully appreciate the value of appealing whenever it is possible to the eye as well as to the ear in our medical work and teaching. In instructing students and in demonstrating methods of operating in our text-books, the appeal to the eye by illustrations is now used with a fair degree of liberality, but there are other fields than these almost untried.

I have recently devised and am now using a chart such as shown in Fig. 1, as a valuable adjuvant in the treatment of cases of cystitis, and it is because I believe that some such ocular demonstration of the progress from week to week ought to be used in every case, that I here offer this simple but serviceable suggestion in the hope of extending its field of usefulness.

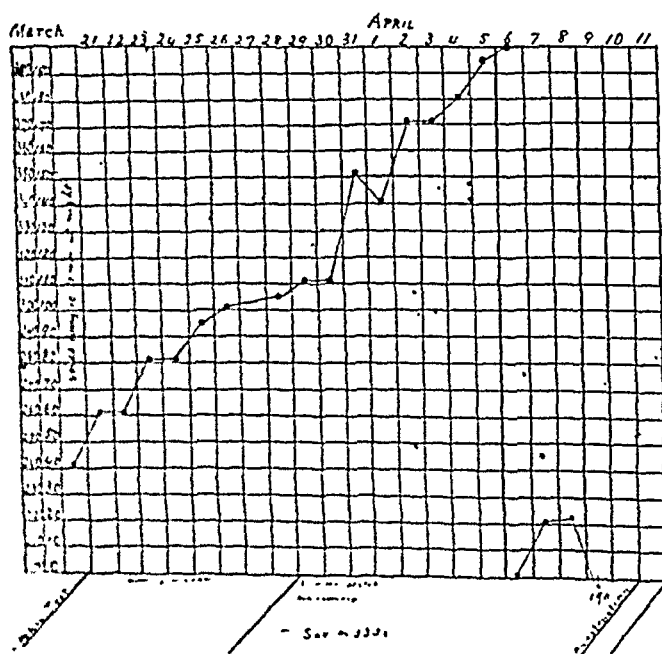
My patient was a married woman, thirty-seven years old. She had had no pregnancies in eight years of her married life. Her general health was good, and the entire complaint was lodged in the bladder, which began about six years ago to trouble her with sticking, knife-like pains in the lower abdomen, which became worse on exertion. Three or four years ago she had a frank attack of cystitis, when she passed a great deal of blood. The added pains associated with this attack have been pretty constant since that time, although there have been occasional remissions. She has often been compelled to void her urine 15 or 20 times a day as well as incessantly at night. She was so worn-out and nervous from her sufferings that she could not even endure an ordinary gently executed cystoscopic examination, so I gave her an anæsthetic and then examined the bladder at leisure and very thoroughly through my aero-cystoscope.

At the examination I found an injected area of pronounced cystitis with disappearance of the vesical vessels occupying the left lateral wall of the bladder and a part of the vertex. The rest of the bladder was normal and there was no disease at the base or abnormality about the ureteral orifices.

Treatment was then begun with an intelligent idea as to just what the disease was, where it was located, and how extensive it was. This was valuable also as a basis for comparison in following up the results of treatment.

I followed four courses in treating her: 1. Rest, not absolute

FIG. 1.



but relative. She was required to take things very easy and to lie about especially after the treatments. 2. Medication, there was but little medicine given by the mouth. 3. Local therapy, which constituted the sheet anchor in the treatment and to which she owes her improvement almost exclusively.

This consisted in distending the bladder to a maximum at first with a warm boric acid solution, followed at the end of the irrigation and distention by the instillation of a solution of nitrate of silver (1:1500).

At the suggestion of Dr. C. F. Burnam, my associate, I later used a carbolic acid solution ($\frac{1}{2}$ pc.) for the distentions, on

account of the sedative action of the drug as well as its value in sterilizing the surfaces with which it came into contact.

After the treatment was well under way, I conceived the idea that it would be a great help to the patient as well as to me if a large graduated chart like a temperature chart were made and hung on the wall, for the purpose of showing at a glance just what progress had been made from the first, what the actual status was at any given time, and what was expected for the future, that is to say, how great was the distance still remaining to the goal.

Such a chart serves both doctors and nurses as an excellent basis of appeal to the patient to do her best, and is a moral stimulus in moments of depression. She will not then be so likely to worry over little diurnal variations with the written record of decided improvement before her.

One can also determine the effect of psychic or of physical causes on the toleration of the bladder as well as the beneficial effect of any particular drug being used. In this special case my goal is a content of 500 c.c. (one pint). Starting out with an intolerant bladder tolerating only 40 c.c. (a little over an ounce), we have gone steadily up to over ten times the amount in seven weeks; no bad record for a case of years' standing. With this measured and charted improvement has gone a like improvement in all the symptoms. She used to void from 10 to 15 times at night, now it is but once or not at all.

On reaching the top of the chart one may begin again at the bottom using the left-hand column of figures with 200 on the lowest line and ascending to 400. When she runs again to the top I will write 400 to the left of the 200 column and carry the enumeration up to 500 or 600, where we will stop.

To effect this improvement I have given her 36 irrigations and 140 distentions. That is to say the bladder is irrigated every day if there is no reason to the contrary, and at each irrigation it is distended several times to a maximum.

In addition to the encouragement such a chart gives patient, nurse, and doctor, it is a great time saver and saves reading over the daily records to see what has been effected.

The individual squares in the figure are 1.5 cm. each way. I would make the chart long enough to hold from 30 to 50

treatments, and count each square equal to 10 c.c. of distention. Checker paper or chart paper can be bought for a few cents a sheet in larger or smaller squares suitable to hang on the wall or to file away with the history. A fine paper is Webb's co-ordinate draughting paper, which comes retail at 5 and 10 cents a sheet, less in quantity.

IS THE SAC OF A FEMORAL HERNIA OF CONGENITAL ORIGIN, OR ACQUIRED?

BY R. W. MURRAY, F.R.C.S.,
OF LIVERPOOL, ENG.

THERE is an ever-increasing tendency to regard the sac of an ordinary inguinal hernia as being of congenital origin and not acquired. The evidence that can be advanced in support of this view is very complete and convincing. In this communication I wish to direct attention to the etiology of femoral hernia, and will endeavor to answer satisfactorily the question, "Is the sac of a femoral hernia of congenital origin, or acquired?"

Though the sac of a femoral hernia is almost invariably found to occupy a position between the femoral vein and Gimbernat's ligament, cases have been recorded in which it has been seen in other situations. It has been found to descend in front of the femoral vessels, external to them, behind them, and even to pass through the fibres of Gimbernat's ligament.

Partridge, in the *Transactions of the Pathological Society* for 1847, relates a case of double femoral hernia in which both sacs were outside the femoral vessels. The left sac contained the sigmoid flexure; the cæcum and vermiform appendix were in the right. The accompanying drawing (Fig. 1), which is copied from Macready's "Treatise on Ruptures," shows three sacs—one in the usual position of a femoral hernia, a second peritoneal sac had traversed Gimbernat's ligament, and a third protruded over and to the outer side of the femoral artery.

These three peritoneal diverticula appear to me to have a very important bearing upon the etiology of femoral hernia. Macready tells us that: "The specimen was taken from the body of a woman between forty and fifty years of age, who had a rupture for several years. The hernia is in the usual situation. The abdominal entrance of both the other pouches

was narrower than the fundus, and both were surrounded by fat which had been partly removed by dissection."

How are we to explain the formation of these three peritoneal diverticula?

Surely one of two explanations must be true—either all three sacs had been acquired, or, as appears more probable, all three were of congenital origin. The fact that three diverticula were found in such close proximity is in favor of the developmental view; and this view as to their origin receives support from their shape, for it is distinctly stated that the abdominal entrance of both of these pouches was narrower than the fundus. Had these diverticula been produced by the bowel pushing the peritoneum in front of it, then the mouth of each sac would have been wide.

It might be argued that all three diverticula were acquired; that is to say that all three at one time were hernia sacs, but in two of them the neck and mouth of the sac had become narrowed, having undergone a natural cure. The objection to such an explanation is that clinical experience has never yet furnished a single instance in which an undoubtedly acquired hernia sac has undergone a spontaneous cure. The evidence, then, is strongly in favor of the congenital origin of two of these sacs, and as it is extremely unlikely that an acquired hernia sac would be formed between two existing peritoneal diverticula, we are compelled to believe that, in this instance at all events, the femoral sac was also pre-formed.

Though it is true that femoral hernia is seldom met with before adult life, still a number of cases has been recorded in which the hernia first appeared during childhood, and others in which it was present at birth or noticed during infancy.

In the *ANNALS OF SURGERY* for October, 1906, Wm. B. Coley, writing on the radical cure of femoral hernia, says: "Between the years 1891 and 1906 I performed 117 operations for femoral hernia in 105 patients. In 34 of these operations the patients were children between the ages of two and fourteen years. Nine were males and 18 females. In three operations the patients were under five years of age; in 15 operations the patients were from five to ten years of age; in 14 operations the patients were from ten to fourteen years of age."

In the article on hernia in Keating's "Cyclopædia of the Diseases of

Children," two cases of femoral hernia recorded by Edward Swasey are referred to. "A boy sixteen years of age presented himself at the hospital with unmistakable double femoral hernia. His mother said that when one year old he had a bad bronchial affection, with severe cough, and during this time the tumors appeared. They would disappear on lying down and increase in size on standing up, and especially upon coughing. The boy said the lumps had been present as long as he could remember."

Swasey also mentions another case of femoral hernia in a girl twelve years of age, whose mother positively asserted that the swelling had been present for four years.

Thomas Bryant, in the *Medical Times and Gazette* of 1862, vol. i, reports two cases of femoral hernia which occurred in girls, aged nine and twelve years respectively.

Edmund Owen, in his work on "Surgical Diseases of Children," mentions the case of a female child, six years of age, upon whom he operated for strangulated femoral hernia.

Ashby and Wright, in their work on "Diseases of Children," mention that Sabourin recorded a case of femoral hernia in a premature infant.

John Birkett, writing on hernia in Holmes's "System of Surgery," mentions a case of crural hernia he saw in a girl ten years old.

Lockwood, in his work, "Hernia, Hydrocele, and Varicocele," mentions two cases of femoral hernia upon which he operated, and which he considers might possibly have been congenital. "They occurred in boys aged twelve to fifteen, and had existed for years."

Macready, in referring to persons seen at the City of London Truss Society during the years 1888, 1889, and 1900, mentions 22 cases in which femoral hernia was met with in males under fifteen years of age, and 42 cases in which femoral hernia was noticed in females under fifteen years of age.

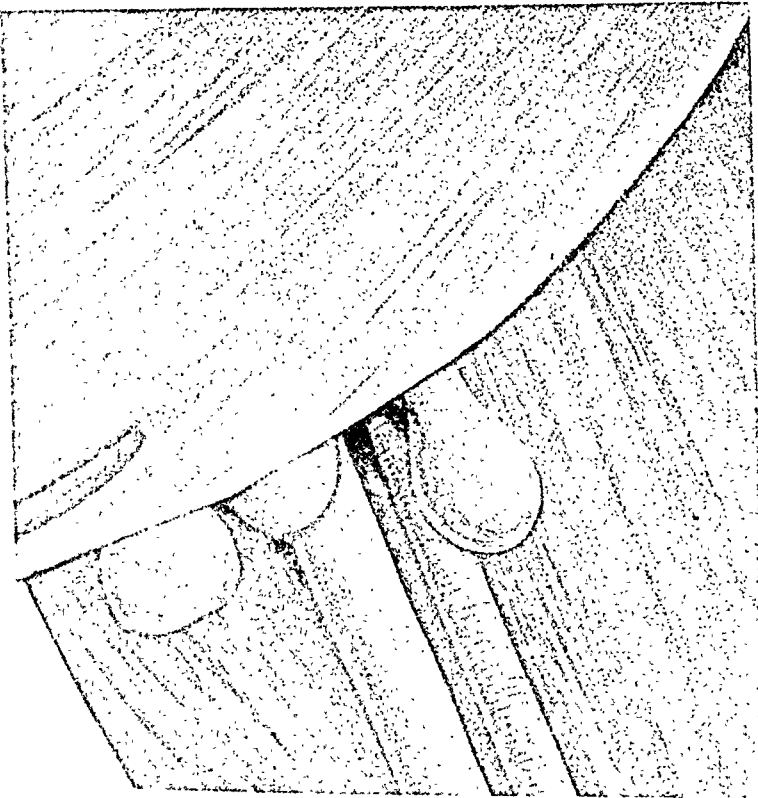
We have, then, 104 cases of femoral hernia occurring in children under fifteen years of age. In 52 of these cases the hernia first appeared between one and ten years of age, and in 9 instances it was first noticed before the children were five years old.

The relative frequency of femoral hernia in male and female children is about 1 to 2.

CASES OF FEMORAL HERNIA IN CHILDREN, ACCORDING TO AGE
WHEN THE HERNIA WAS FIRST NOTICED.

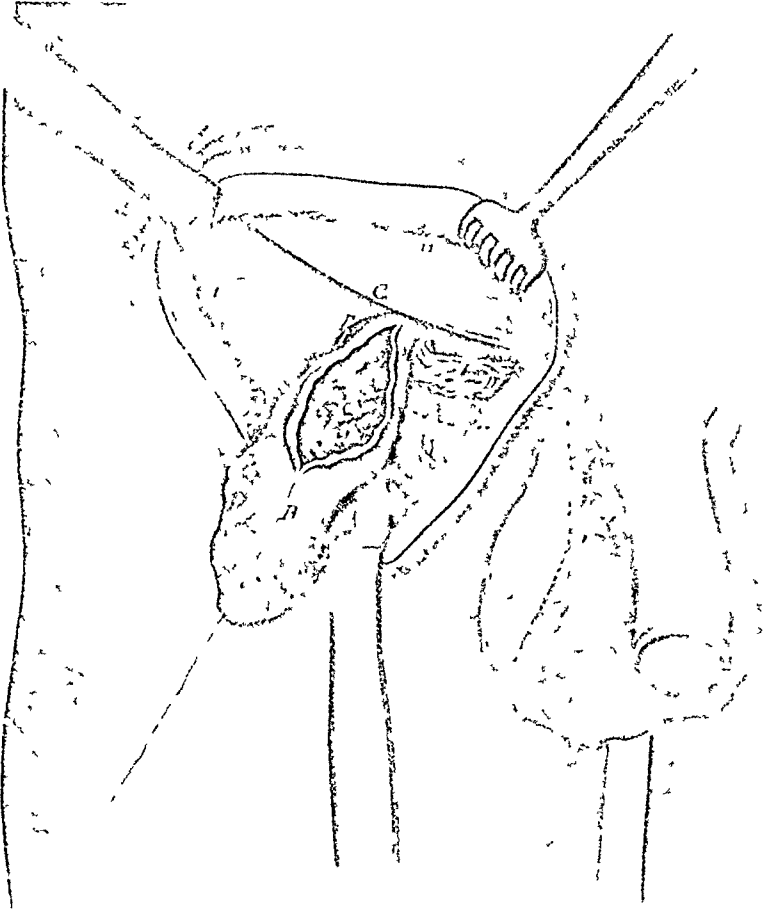
1-5	9
6-10	43
11-15	52
Total	104

FIG. 1.



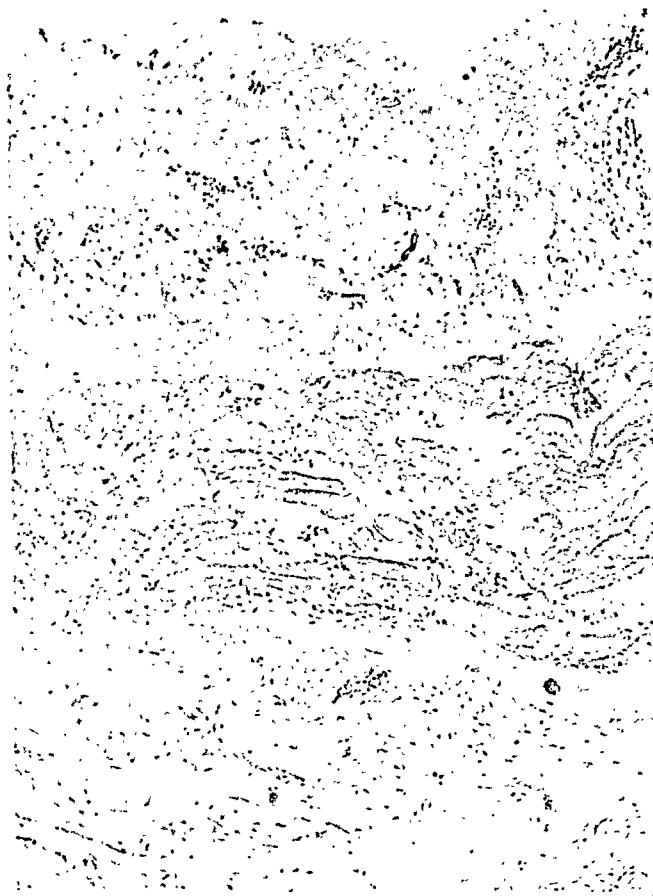
Three crural peritoneal diverticula. The central protrusion is the sac of a femoral hernia in the usual situation. A second sac had traversed Gimbernat's ligament, and a third had protruded over and to the outer side of the femoral artery

FIG 2



Cruroserotal hernia 1 femoral ring B sac C omentum D cord I below the sac F falciform ligament G, Poupart's ligament H aponeurosis externa oblique muscle I Gimbernat's ligament J pectineus muscle

FIG. 3.

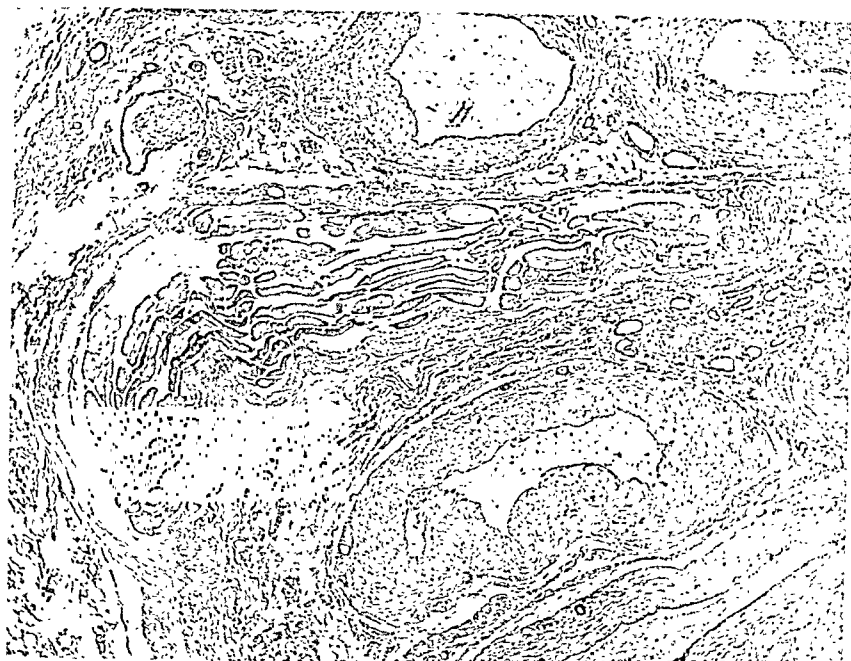


Muscular fibres from the fundus of a femoral hernia sac. (60 diam.)

FIG. 4

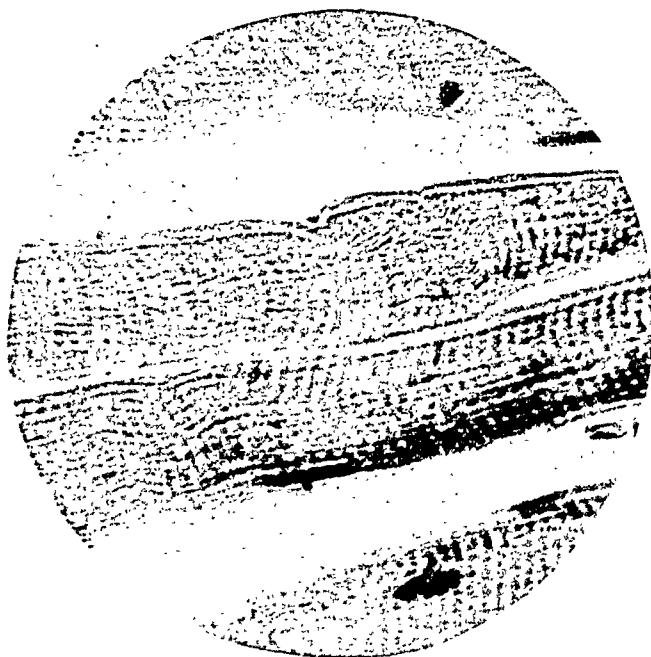


FIG. 5.



Normal gubernacular fibres ($\times 38$ diam.).

FIG. 6.



Higher magnification ($\times 1000$ diam.) of muscle fibres shown in Fig. 5.

In accordance with orthodox teaching, all these 104 hernia sacs had been acquired; but considering the age of the patients, and remembering that in 9 instances the hernia first appeared between one and five years of age, it is surely far more probable that the bowel had descended into a pre-formed sac.

In the case recorded by Edmund Owen, where strangulation of a femoral hernia occurred in a child six years of age, the only possible explanation is that the bowel had suddenly entered a pre-formed sac.

Femoral hernia is so frequently met with that if its essential cause is the presence of a pre-formed sac, then we would expect to find small peritoneal diverticula occupying the crural region, altogether apart from hernia.

In 200 consecutive post-mortem examinations, kindly made for me by Dr. Nathan Raw at the Mill Road Infirmary, upon persons in whom during life there was no history or evidence of hernia, in 47 bodies 52 femoral diverticula were present. In 14 instances they were bilateral. They invariably occupied a position corresponding exactly to that of a femoral hernia, and in shape closely resembled the inguinal pouches, having a narrow mouth and lumen, which would make it appear more probable that they were produced by some force pulling the peritoneum outwards, rather than by a pushing force from within. The fact that in the 47 bodies more than one diverticulum was present in 16 instances strongly suggests a developmental origin for both the inguinal and femoral pouches, and this view is strengthened by one case (No. 9) in which a double inguinal and double femoral sac existed.

I would call attention to the fact that so many of the femoral sacs were bilateral, and that in another case (No. 45), a girl aged seven years, a femoral diverticulum was present on both sides of the body. These femoral pouches are either all of congenital origin or all have been acquired; no compromise can be accepted. If they are all of congenital origin, and occur with such frequency as the tables indicate, and are so often found in the position which the sac of a femoral hernia normally occupies, then why suppose the sac of a femoral hernia is ever acquired?

I would remind surgeons who hold to the orthodox teaching, that if their view be correct then these pouches must have been acquired by the bowel pushing the peritoneum in front of it. Consequently we are asked to believe that amongst 47 persons no less than 58 femoral herniæ must at one time have existed, and that quite unknown to the individuals concerned—a suggestion which, to say the least, is extremely improbable.

Number.	Sex.	Age.	Potential Hernia Sac.
1	Male.	48	Double inguinal and right femoral.
2	"	61	Double inguinal.
3	"	46	Left femoral.
4	"	57	Right femoral.
5	"	39	Right inguinal (contained omentum).
6	"	55	Left inguinal (contained omentum).
7	"	42	Left femoral.
8	"	29	Right femoral.
9	"	44	Double inguinal and double femoral.
10	"	30	Right and left femoral.
11	"	63	Right and left femoral.
12	"	62	Right femoral.
13	"	32	Left inguinal.
14	"	45	Right femoral.
15	"	60	Right femoral.
16	"	61	Right and left femoral.
17	"	44	Right femoral.
18	"	64	Right femoral.
19	"	33	Right and left femoral.
20	"	54	Right femoral.
21	"	22	Right and left inguinal.
22	"	63	Right femoral.
23	"	44	Right and left femoral (small opening).
24	"	64	Right and left femoral (small opening).
25	"	28	Right and left femoral.
26	"	31	Right femoral.
27	"	44	Left femoral (small opening).
28	"	24	Right femoral.
29	"	56	Right and left femoral and umbilical.
30	"	55	Left femoral.
31	Female.	40	Right femoral.
32	"	14	Right and left femoral.
33	"	62	Left femoral.
34	"	54	Right femoral.
35	"	33	Right femoral.
36	"	60	Right and left femoral.
37	"	47	Left femoral (contained omentum).
38	"	56	Umbilical (contained omentum).
39	"	30	Left femoral (small opening).
40	"	43	Right femoral.
41	"	30	Right femoral.
42	"	37	Left inguinal.
43	"	44	Right femoral.
44	"	62	Right femoral.
45	"	7	Right and left femoral (small opening).
46	"	68	Right femoral and left inguinal.
47	"	18	Left femoral.

Two hundred bodies examined: In 47 bodies 68 peritoneal diverticula were found; in 16 instances more than one diverticulum was present.

30 males..... { 1 umbilical.
11 inguinal (4 double).
34 femoral (11 double).

17 females..... { 2 umbilical.
2 inguinal.
18 femoral (3 double).

It is a well-known fact that femoral hernia occurs with far greater frequency in women than in men, and, granted that a femoral sac occurs with equal frequency in both sexes, I would suggest that a hernia is more likely to occur in women, mainly for two reasons: (1) because in females the lateral expansion of the pelvis which takes place about puberty would tend to widen the mouth of a peritoneal diverticulum in the femoral region; (2) on account of increased pelvic pressure during pregnancy.

This suggestion receives support from the fact that femoral hernia appears with greatest frequency between the ages of twenty-one and forty-five years, the child-bearing period.

That it is possible, owing to some developmental irregularity, for a peritoneal diverticulum to occupy the crural canal, is clearly demonstrated by the accompanying drawing (Fig. 2), which illustrates an article in the *ANNALS OF SURGERY* for January, 1909, by Alexander Hugh Fergusson, of Chicago. The patient had suffered from a hernia in his right groin for 27 years. "He dated his rupture to a time when he was eighteen years of age, and was pitching hay on a farm. An extra effort was made with the pitchfork to heave hay, when suddenly he felt something give way in his right groin, and at once a tumor mass appeared in the scrotum."

In the following case, taken from the *Epitome* of the *British Medical Journal* for October 5, 1907, there can be little doubt, from the family history and the operative findings, as to the congenital origin of the hernia.

C. Provera¹ describes the case of a woman of twenty-four who came up for operation with a right crural hernia of a year's standing. Her brother had a right inguinal hernia, and one of her three sisters had bilateral hernia. The patient's tumor was the size of a walnut, painless excepting at the time of the menstrual flow, and reduced itself spontaneously when she lay down. When the sac was found, it had in its outer part a pink, rounded cord, the size of a goose's quill, looped. Light traction on the inner side of the sac brought part of the bladder into view, just at the point where the ureter, here reddened and dilated, entered it. The sac itself contained a little piece of omentum. The operation was performed

¹ *Gorn d. R. Accad. di Med., Turin, 1907, 131.*

in the usual way, and the patient made a straightforward recovery; at no time did she have any renal, ureteral, or vesical symptoms. Provera gives and discusses the literature of the subject.

I have not the least doubt that if the literature of the subject were carefully reviewed, a large number of cases would be found in which a femoral hernia had first appeared during infancy or childhood, but these mentioned are amply sufficient for the purpose. The earlier in life a hernia appears, the greater the probability of its being due to a developmental defect.

Clinical evidence, then, is strongly in favor of the belief that in a number of cases the sac of a femoral hernia is pre-formed, and is, therefore, the essential cause of the hernia.

The results obtained after operating for the cure of femoral hernia favor the view that the primary cause of the hernia is the presence of the sac; for if the sac were acquired owing to weakness of the abdominal wall, recurrence of the hernia after operation should very frequently take place, as for anatomical reasons it is extremely difficult to strengthen the abdominal wall at this point. Yet we know that most satisfactory results have been obtained after complete removal of the sac alone, without any attempt being made to reinforce the abdominal wall at the site of the hernia.

If, then, in some cases a pre-formed sac does determine the occurrence of a femoral hernia, and in many persons a peritoneal diverticulum persists throughout life, but is so small that the bowel has never entered it, it is surely rational to believe that in all cases and at all periods of life the occurrence of a femoral hernia is due to the fact that a potential hernia sac occupies the crural canal.

Granted the presence of a diverticulum, the descent of the bowel would depend, as in the inguinal or any other region, upon the size of the mouth of the sac. If the sac is a relatively large one, then the hernia may appear during infancy or childhood; if, as is more usually the case, the sac is at first small, then the bowel is not able to enter it, until with the growth of the individual it has attained a certain size.

It is generally admitted that the gubernaculum, a fibromuscular mass, is in some way responsible, not only for the descent of the testicle into the scrotum, but also for the descent of the processus vaginalis, which reaches the bottom of the scrotum in advance of the testicle.

About the sixth month of fetal life the gubernaculum extends from the lumbar region through the inguinal canal, and has its chief attachment at the bottom of the scrotum; but bands also pass to the groin and to the root of the penis; others end in the peritoneum.

These additional bands are normally slender, but occasionally are sufficiently developed to influence the direction of the testicle, which may then be found in the perineum, at the root of the penis, or in the crural canal (Lockwood).

Whether it is by muscular action or by cicatricial contractions that the gubernaculum assists in the descent of the testicle and of the processus vaginalis, is still a disputed point, but that it does play a very important part in these changes is rendered probable by the nature of its structure, and by the fact that a remnant of gubernaculum can always be found in the adult, behind the epididymis and the testicle.

In the case of the cruroscrotal hernia above referred to (Fig. 2), it is, I take it, fair to assume that the abnormal descent of the testicle and processus vaginalis was most probably due to the abnormal attachment and development of the crural termination of the gubernaculum.

The evidence that we have, then, justifies us in assuming:

1. That the chief gubernacular band is attached to the bottom of the scrotum, and is responsible for the formation of the processus vaginalis, and for the descent of the testicle.
2. When the testicle together with a process of peritoneum is found to occupy the crural canal, it is probably due to an excessive development of a normally slender gubernacular band.

It is then reasonable to believe that a crural gubernacular attachment, developed in excess of the normal, may, without producing an abnormal descent of the testicle, drag upon the peritoneum sufficiently to make a dimple in the crural

region, which, with the growth of the individual, will develop into a potential hernia sac.

The surprising frequency with which crural peritoneal diverticula were found in the bodies examined at Mill Road Infirmary may thus be explained.

The shape of these diverticula and their narrow lumen strongly suggested that they were produced by some force pulling, rather than pushing, the peritoneum outwards.

If the sac of a femoral hernia is formed originally in this way, then some atrophied gubernacular fibres should be found at the fundus of the sac. At the same time it must be remembered that in any case the fibres will be scanty.

A few weeks after I had written the above remarks I secured, in the post-mortem room, from the body of a man sixty-one years of age, the sac of a femoral hernia. I sent the sac to the Clinical Research Association in London, asking that the fundus might be carefully examined for gubernacular fibres. This was done, and on November 30, 1909, I was delighted to receive the following report, together with a microscopic slide: "Sections made longitudinally of the fundus of this hernial sac certainly show small bundles of striated muscle. They can easily be picked out by their characteristic appearance, nuclei, striated sheath, etc." A photomicrograph of the slide is reproduced in Figs. 3 and 4.

So far as I am aware, this is the first time muscular fibres have been demonstrated at the fundus of a femoral hernia sac, but that is only because it is probably the first time they have been looked for there. It is, I hope, reasonable to infer that these muscular fibres are the remains of the gubernaculum, and further that as the scrotal band of these fibres influences in some way the descent of a peritoneal diverticulum into the scrotum, so a crural attachment of gubernacular fibres may in some way determine the formation of a peritoneal diverticulum in the femoral region.

Some of my friends to whom I showed this slide expressed a doubt as to these muscular bundles being gubernacular fibres, chiefly on account of their striation. For my own part, I

failed to see how the presence of muscular fibres at the fundus of a femoral sac could possibly be anything else than the remains of the gubernaculum. However, in order to clear up this point, I had the microscopic section, which is reproduced in Figs. 5 and 6, made for me by the Clinical Research Association. It was obtained from an adult, after making a series of sections of the structures immediately behind the epididymis. It represents normal gubernacular fibres in the mesorchium, and the striation of these fibres is seen distinctly.

One would expect striation to be more pronounced in the scrotal band of gubernacular fibres than in the crural, perineal, or any other band, owing to the gubernaculum blending with the internal oblique and transversalis muscles in its descent to the scrotum.

I trust it may be my good fortune to have an opportunity of examining an obturator and a sciatic hernia sac, for I feel confident that, if looked for, muscular fibres will be found at the fundus of both these sacs.

The discovery of gubernacular fibres at the fundus of a femoral sac is, to my mind, very strong evidence indeed of the congenital origin of hernia in this region.

I have not yet had the opportunity of searching for muscular fibres at the fundus of a femoral hernia sac in a woman, but feel confident of finding them there. In the female a structure corresponding with the gubernaculum is responsible for the descent of a peritoneal diverticulum into the inguinal canal, and I believe that in both sexes a crural band of these fibres is responsible for the occasional formation of a peritoneal diverticulum in the femoral region.

I have already explained why femoral hernia is met with more frequently in women than in men, and in conclusion would submit that clinical experience, operative experience, and also evidence obtained from the post-mortem room and from the pathological laboratory are strongly in favor of the view that the sac of a femoral hernia is of congenital origin and not acquired.

SILVER WIRE AND LINEN THREAD FOR THE CURE OF HERNIA.

BY JOSEPH WIENER, M.D.,

OF NEW YORK,

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IN a former paper¹ the writer drew attention to this "somewhat neglected field of reparative surgery." To the seven cases reported in 1906 he has been able to add many others. The great satisfaction he has received from these cases and the permanency of the results attained have induced him to make a detailed report.

It is just ten years since our attention was first called to the subject of wire filigree almost simultaneously by Witzel and Goepel. Witzel did not use a ready-made filigree. He first partly closed the hernial opening with a few silver sutures, and then covered over the opening still remaining with numerous thin silver wires passed in every direction. This method was good, but rather slow. To Goepel belongs the credit of having first made use of the ready-made filigree. He reported eleven cases of ventral and umbilical, and seven cases of inguinal hernia with sixteen cures. In the other two cases he removed the filigree on account of the formation of a hæmatoma. We now know that this is unnecessary, as the wound will heal even if a hæmatoma develops. Moreover, there may even be some wound infection with subsequent sinus formation, and yet the silver wire or the filigree need not be removed. It need hardly be said that hæmatoma formation is no more likely to result with silver wire than with catgut. Careful hæmostasis and a firm compression dressing will prevent it.

We make use of silver wire in two forms. The one consists of a suture made of fine strands of wire in the shape

¹ The Use of Silver Wire for the Cure of Large Herniæ, *ANNALS OF SURGERY*, April, 1906.

of a cable. This was devised by Dr. Howard Lilienthal, and we can recommend it most heartily. It is made in various sizes, is much stronger than the ordinary silver wire, much more pliable, and can be tied into a knot with ease. Where the hernial opening is very large we use a filigree made of thin silver wire. We use a filigree somewhat on the order of that described by Bartlett, of St. Louis, in volume xxxviii, *ANNALS OF SURGERY*, 1903.

To quote from the former paper of the writer:

"The filigree I have employed has been that devised by Bartlett, and I have followed his directions closely. He advised the use of the ready-made filigree, made of thin wire, not heavier than gauge No. 30. The heavier wire is not resilient enough, and does not adapt itself so well to the tissues, and in consequence it is apt to cause irritation. Another advantage of the filigree over silver-wire sutures is the fact that it can be introduced very quickly. Furthermore, and this is a matter of great importance, the filigree can be placed between the tissues at a much greater distance from the edges of the opening than would be possible in passing a needle. It should widely overlap the hernial opening on all sides. No sutures are required to hold the filigree in place. If any one doubts the correctness of this statement, he has but to remember what happens when we inadvertently leave a piece of gauze in a wound. How quickly are the meshes of the gauze filled with granulation tissue, which anchors it in place so firmly that it can only be removed with the greatest difficulty. The same process goes on with the filigree. In a few weeks it is so firmly anchored in place that great force is required for its removal. This has been proven experimentally on animals. Another advantage in not suturing the filigree in place is the fact that it can then better adapt itself to the surrounding tissues, and there is less likelihood of its causing irritation. If properly made and properly inserted it should cause no discomfort whatever; the patient should not be aware of its presence. . . . As is well known, scars in the abdominal wall generally spread most in a lateral direction. The filigree, which can be readily made by any one, depends for its efficacy upon the fact that all but one of the wires run across the long axis of the hernial opening. The filigree should overlap the opening by at least an inch all around. It is so made that each cross wire ends in a loop, thus obviating sharp ends. If sutures of silver wire are used, they should not attempt to approximate the tissues (a frequent cause of failure). It is always better to depend on two layers of silver; either two filigrees in two different planes, or one filigree and one reinforcing layer of silver sutures, provided the superficial muscles or fascia can be approximated without any tension. In general it is well to place the filigree as deeply as possible; sometimes it is not necessary to open the peritoneal cavity. But the filigree must extend well beyond the hernial opening on all sides. This necessitates dissecting up the muscles all

around before introducing the filigree. Then the superficial plane of muscles or fascia may be united with silver-wire sutures, or a second filigree is introduced. Or a filigree can be made by a running suture of wire that does not approximate the tissues, but simply fills the gap. By following this method we have a double guard against recurrence of the hernia."

The filigree should be so pliable that it will bend with respiratory movements. It will then accurately mould itself during the healing process to the locality in which it is placed, and it will not cause any local irritation, which would necessitate its removal. The meshes should not be too close and the wire should not be too heavy. It is surprising how well such a flimsy looking filigree, when it has healed into the tissues, will prevent the recurrence of a hernia. The writer has several cases that have been doing severe physical labor for four and five years, in perfect comfort, and without any relapse. If such cases are examined a few months after operation it is impossible to feel any part of the filigree, so effectually has it become imbedded in the tissues.

The indications for the use of silver wire will vary with the individual operator, and some surgeons never use it. A recent English writer, McGavin, uses it in old people with large hernial openings, in people who habitually throw an extra strain on their abdominal muscles, in patients with poorly developed abdominal muscles, and finally in recurrent herniæ. To these groups of cases we would add one other, cases in which the muscles and fascia cannot be approximated without tension.

In recurrent cases, if the first operation was properly done and the wound healed by primary union, then a second Bassini operation done on the same tissues is not likely to be permanently successful. Where Poupart's ligament or the oblique muscles, or both, are poorly developed, it is not fair to expect any better result the second time than the first, if the ordinary suture material is employed. We have been using silver cable sutures in these cases with good results. We have also used a filigree in a few very large inguinal herniæ. Even if we succeed in dragging the attenuated oblique muscle

over to the poorly developed Poupart's ligament, is it not asking too much to expect some tissues to permanently prevent the reformation of a hernia? Even using the rectus muscle or its sheath is in many cases unsatisfactory. And yet we have seen surgeons do a third, or even a fourth Bassini operation (with catgut) for recurrences. Each time they went through the form of a typical operation, using the same poorly developed tissues that nature had unmistakably declared to be unfit for the work at hand.

Why there should be a sentimental objection to putting a so-called foreign body into the wound, in the shape of silver sutures or a filigree, we have never been able to understand. And why some men prefer to do most extensive plastic operations for the cure of herniæ, which often fail to give a permanent cure however pretty they may look on the table, in place of the simple and reliable procedure of using a filigree, is also hard to understand. For after all we are not dealing with a matter of sentiment, nor is our object the doing of a pretty piece of work. Our problem is rather the plain and prosy one of curing a large or a recurrent hernia, where the anatomical conditions are such that autoplasmic operations do not give much chance for radical cure. The usual objection we hear is that the filigree will irritate and will have to be removed. The answer to this, in the light of our experience, is very simple. If the proper wire is used in the first place, if the filigree is properly made in the second place, and if it is properly introduced in the third place, it will very seldom be necessary to remove a filigree. Personally we have only once been compelled to remove one, where it was introduced as a ready-made filigree. In no case have we had to remove a filigree when made of running sutures of wire. In some of our cases there has been some superficial infection of the wound, especially in fat patients, due to trauma of the fat. In such cases a sinus has remained for a longer or shorter period, but except in the one case referred to above we have never removed the filigree or the wire sutures, and the wounds have all healed. In the majority of cases, with

proper materials properly employed, our wounds have healed as rapidly as in cases in which we have used absorbable sutures. Where the filigree is made of running sutures, the silver cable wire devised by Dr. Lilienthal will be found much more satisfactory than ordinary silver wire. Where there is much gaping of the tissues, no attempt is made to approximate them. The gap is filled by running sutures back and forth in figure-of-eight style. In some cases a filigree made beforehand may be used. This may be placed between the peritoneum and transversalis, or the filigree may be used in a more superficial plane.

CASE I.—Israel M., fifty-three years old, was first admitted to Mount Sinai Hospital in November, 1902. There had been a gradually increasing right inguinal hernia for three years. The hernia had been irreducible for one year, and there had been several attacks of abdominal pain. The hernia, on admission, was 58 cm. in circumference and was only partly reducible. On opening the sac, Dr. Lilienthal found it to contain small intestine, cæcum, and ascending colon, the latter firmly adherent to the sac. The adherent appendix was removed. The sac was so firmly adherent to the cord and testis that their detachment was impracticable. Testis cord and part of the sac were removed; the intestines were replaced, and the neck of the sac closed with chromic gut. No sutures were used; the wound was packed with gauze and a compression bandage was applied. During convalescence there was some sloughing of the fascia and of the deeper tissues. A large exudate which formed in the scrotum required incision. The man left the hospital after two and a half months, wearing a truss. Six months later he returned to the hospital. The hernia could no longer be retained by a truss; it was only partly reducible and prevented the man from earning a living. The dangers of a radical operation were explained to him, but he begged to have it done. On August, 1903, I excised the scar tissue and opened the sac. The many coils of small intestine could not be reduced until the patient had been placed in extreme Trendelenburg's position. Even then it was very difficult. The sac was freed from adhesions and tied off. The inguinal canal was so large that it was impossible to close it with sutures. The ring was narrowed by a purse-string suture of silver wire. A filigree was now placed over the inguinal canal, and the superficial fascia and skin brought together with sutures. Following the operation we attempted to keep the foot of the bed elevated, but unfortunately this caused nausea, retching, cyanosis, and dyspnœa. Although the bowels moved daily, the man was always restless and uncomfortable. Three days after operation he began to vomit, restlessness and cyanosis increased, and six days after operation he died. Examination showed that the filigree was in place and that there had been no infection whatever. Death was caused by the fact that

the abdominal cavity could not accommodate itself to the large amount of intestines that had been in the sac.

CASE II.—Mrs. Ray M., thirty-four years old, was referred to me by her physician. In October, 1900, she had been operated on by the late Dr. Bull, who removed diseased adnexa through a median incision. A hernia developed in the scar five months after operation. A few months later there was a sudden attack of pain in the right side of the abdomen, accompanied by vomiting and fever. This attack was followed by similar ones. The hernia increased in size, it became painful, and the truss no longer retained it. Operation, October 27, 1904. The sac contained a large mass of omentum. The omentum was replaced, the appendix removed, the sac dissected out and tied off. The peritoneum was closed with a running catgut suture. The posterior sheaths of the recti and the muscles themselves were approximated with chromic sutures. It was not possible to close the opening in the fascia entirely. With silver-wire sutures passed from side to side to form a filigree, the gap was filled in. The skin was closed with silk. The wound healed by primary union. Five and a half years have elapsed since this operation was performed, and the patient has been perfectly comfortable and has had no relapse.

CASE III.—William K., thirty years old, admitted January 6, 1905. There had been an oblique right inguinal hernia for three years, and a similar hernia on the left side for one year. Operation on the right side by Dr. Lilienthal. For the Bassini sutures twisted silver-wire sutures were used. The operation on the left side was performed by the writer. There was such a wide separation of the deeper structures that it was impossible to approximate them. The gap was bridged over by a running silver suture, returning the suture so as to make a sort of figure-of-eight filigree. The superficial fascia and skin were sutured separately. Both wounds healed by primary union.

CASE IV.—Louis R., thirty-seven years old, admitted May 5, 1905. Two months before admission the man, while getting off a moving car, was thrown against a steel column. He sustained a fracture of the humerus, dislocation of the clavicle and three upper ribs, and a large ventral hernia in the left iliac fossa. On May 9 I performed a partial excision of the clavicle and three upper ribs. Eight days later I exposed the ventral hernia through a three-inch transverse incision. The peritoneum was not opened. A silver filigree two by three and a half inches was placed between peritoneum and transversalis. The external oblique was approximated with a running silver-wire suture and the skin with silk. The wound healed by primary union. The man has not suffered any discomfort from the wire.

CASE V.—Tony M., twenty-four years old, admitted July 10, 1905. In 1901 there had been an operation for appendicitis. A year later a hernia developed in the scar; it had always been reducible until two weeks before admission. At that time the hernia suddenly became larger and vomiting set in. The hernia was five inches wide and three inches long. On the surface of the mass there were several small ulcers. Operation, July 12, 1905. Hernioplasty with resection of gut, for large ventral hernia

with gangrene of gut. The hernia consisted of several loops of firmly adherent small intestine. One loop had perforated the skin and formed the large ulcer on the surface of the skin. On account of its poor condition six inches of this loop, together with the adherent skin, were resected. End-to-end anastomosis with the Connell suture was done. The circulation in the adjacent loop of gut was not very good, and two pieces of rubber dam were placed around the suture line. As the patient's condition was poor, and as the operation had already consumed considerable time, it was decided to use silver wire to close the abdominal wall. The hernial ring was freed and through-and-through silver-wire sutures were passed from side to side. In this way the greater part of the wound was closed. The drains emerged from the centre of the ring. The skin was closed with silk. For two weeks there was a slight fecal discharge from the wound. Thereafter the wound healed steadily, and the patient left the hospital with a healed wound on August 16, 1905. Since then the girl has been doing arduous housework, including lifting of heavy weights, without any pain or discomfort.

CASE VI.—Golde B., thirty years old, admitted October 3, 1905. The patient had an umbilical hernia of five years' standing. Five days before admission the hernia had for the first time become irreducible. The bowels could not be moved and vomiting set in. The hernia was the size of an orange, tense, and tender. Operation on October 3, 1905, immediately after admission. The sac contained omentum and one loop of small intestine. The gut was replaced and the omentum resected. Three sutures of silver wire almost completely obliterated the diastasis at the neck of the sac. A few catgut sutures approximated the superficial tissues. A small cigarette drain was introduced and the skin closed with silk. The wound was entirely healed in sixteen days. It would not have been possible to have brought the fascia together in any other manner. Three months later, after a severe attack of bronchitis, the patient developed a small hernia just below the umbilicus. Had a filigree been put in besides the wire sutures, this would probably not have occurred.

CASE VII.—Mary M., twenty-seven years old, admitted October 3, 1905. Two weeks before admission the woman noticed a mass in the right hypochondrium and epigastrium. The mass was hard, smooth, adherent to the abdominal wall, and measured about three by five inches. The tumor was excised through a vertical incision in the right hypochondrium. It involved the right rectus and the adjacent portions of the oblique muscles; it was also adherent to the parietal peritoneum. Portions of the oblique muscles, the rectus, including both its sheaths, and the adherent peritoneum were removed, together with the tumor. It was only with difficulty that the peritoneum could be brought together with catgut sutures. A filigree was then placed in the depth of the wound, and a second filigree made by passing running sutures of silver wire through the oblique muscles. A drain was placed at either angle and the skin approximated with zinc oxide plaster. The pathologist, Dr. Mandelbaum, reported the tumor to be an inflamed fibroma. Recovery was rapid and uneventful.

The above seven cases were reported by the writer in his previous paper referred to before. The cases reported below have been operated upon by the writer since 1905. They form but a small proportion of the total number of hernia cases which he has operated on by other methods during this time. But, with increasing experience, silver wire is being used by him in a larger proportion of the cases with the most gratifying results.

We wish to state here that during the past eighteen months we have entirely discarded chromic catgut in hernia cases. We were led to this step by seeing several hernias, done by competent surgeons, that recurred within six weeks after the time of operation. All these cases had been simple cases of inguinal hernia which had healed without any infection. After giving the matter some thought, we came to the conclusion that this unfortunate condition could be explained in only two ways: either the catgut knots opened as the result of coughing or vomiting, or the catgut was absorbed too soon and allowed a recurrence. The writer had also frequently noticed at operations that some strands of chromic gut were very brittle, and sutures sometimes had to be passed several times before a good strand was found.

All these facts induced the writer to discard chromic gut in hernia cases. Where a patient's welfare and the success of an operation are to so great an extent dependent on the suture material, it has seemed to us that we should use the safest material we can find. Catgut, no matter how prepared, is not safe. But we have a material which is easily prepared, which is always sterile, which is never quickly absorbed, and with which the knots never open spontaneously. We refer to Pagenstecher linen. We have used this in over 100 operations, most of them herniotomies. Among these cases we have as yet seen no recurrence. We use No. 2 or No. 3 size, and seldom have it tear. It does not irritate the tissues, almost all the cases have healed by primary union, and they have stayed healed. We were warned when we began this work that in many cases we would be compelled to remove knots. Fortunately this has not happened. Our

wounds have healed just as satisfactorily as when we used catgut. In only a single case were we compelled to remove any sutures. That was in the case of a physician, who was very fat, on whom we did a difficult hernioplasty. He developed a fat necrosis (undoubtedly due to trauma at the operation), a sinus remained until we removed the linen sutures under local anæsthesia six weeks after operation. This case is also free from recurrence. In not another case were we compelled to remove any of the linen sutures after operation. The more we use the material, the more pleased we become with it. It is certainly a satisfaction at the time of operation to know that we are using sutures that will not be absorbed too soon. If we have a recurrence after the use of linen sutures, we can say with certainty that the material is not to blame, and many recurrences after the use of chromic gut can, we firmly believe, be correctly attributed to the catgut. So that in all simple hernia cases, whether inguinal, femoral, or ventral, we use linen sutures. In all recurrent cases we use silver wire. The linen is wound on glass spools, boiled for fifteen or twenty minutes, and preserved in 95 per cent. alcohol.

We have not reported in detail any of the cases in which linen sutures were employed, as they ran the same course as cases where catgut was used. All the case reports in this paper deal with cases in which silver wire, in one form or another, was employed.

CASE VIII.—Israel F., sixty-two years old, admitted February 26, 1906. There had been a right inguinal hernia for ten years and a left inguinal hernia for two years. The man had worn a truss for many years. Both herniæ were reducible. Operation February 27, 1906, under local anæsthesia. Right side: The intestine in the sac was reduced and the sac resected. Both the internal oblique and Poupart's ligament were very atrophic and relaxed and there was a wide hiatus between them. The upper angle was closed with chromic gut, but it was impossible to close the lower part of the wound, on account of the wide separation. Accordingly, a running suture of silver wire was introduced to form a filigree. No tension was made on this suture and no attempt was made to drag the tissues together.

Catgut was used for the aponeurosis and silk for the skin. Left side: Similar anatomical conditions were found and a similar operation was performed. Both wounds healed by primary union, and the man went home on March 16.

CASE IX.—George E., fifty-five years old, admitted October 4, 1906. The man had had a left inguinal hernia for many years. During the past two years it had been only partly reducible and had been increasing in size. The right ring admitted one and a half fingers, and there was an impulse on coughing. On the left side there was a hernia as large as a child's head, containing many loops of gut, which could be returned only with difficulty. Operation, October 5, 1906. The sac was opened and the loops of small intestine reduced. The transverse colon and the sigmoid were adherent to the sac and were reduced only after the adhesions were divided. Extensive dissection was required to free the sac, which was tied off with a chromic gut suture. It was not possible to suture the conjoined tendon to Poupart's ligament on account of the wide diastasis. They were approximated by two running sutures of silver-wire cable sutures. To strengthen the wire it was braided with a piece of chromic gut (a good device). The fascia was sutured with chromic gut, the skin with silk. A small tube drain was placed in the scrotum. The wound healed by primary union, and the patient left the hospital on October 21.

CASE X.—Sarah K., thirty-three years old, admitted January 9, 1907. Two years before admission the patient had had both ovaries removed. One year before that an umbilical hernia had appeared, which slowly increased in size in spite of a truss. Four months before admission a hernia showed itself in the median coeliotomy scar; this became gradually larger. On examination, we found a small umbilical hernia containing adherent omentum. Below the umbilicus there was a scar from a median wound which had evidently been drained at its lower angle. Just to the right of this scar there was a reducible hernia as large as a fist. January 11, 1907, hernioplasty for umbilical and ventral hernia. A median incision was made, starting above the umbilicus and extending to within two inches of the pubis. Adherent omentum at the umbilicus was resected and the umbilicus excised. The fascia and muscle surrounding the ventral hernia were then dissected free, disclosing a hiatus of four inches with very thin fascia. The peritoneum was closed with catgut. The

deep fascia and muscle were together approximated with chromic gut, the muscle thereby being placed under considerable tension. A silver-wire filigree was placed over this suture layer, and a running suture of silver cable wire was passed through the edges of the superficial fascia in the form of a filigree, as approximation was not possible. The deep layer of the fat was closed with a few catgut sutures. A split rubber tube was placed at either angle of the wound and the rest of the wound strapped with zinc oxide plaster. Time of operation was fifty-five minutes. The patient developed a postoperative pneumonia, which caused her death four days after operation.

REMARKS.—To-day I would not make any attempt to suture muscle and fascia in a case of this kind. After closing the peritoneum I would place a filigree between the peritoneum and the deep fascia, and a second filigree between the superficial fascia and the muscle. Such an operation could be done in half an hour and the danger of a pneumonia minimized. We believe that the deaths from pneumonia, following operations for umbilical hernia in fat patients, will be much fewer if less extensive dissections and shorter operations be undertaken.

CASE XI.—Abraham K., twenty-two years old, admitted June 26, 1907. The man had been operated on by another surgeon two years previously for a right inguinal hernia. The typical Bassini operation had been done, chromic gut sutures had been used, one suture having been passed above the cord. The wound had healed by primary union. We found a small reducible recurrent inguinal hernia on the right side. Operation June 28, 1907. The sac was excised and the cord freed; the recurrence was at the lower angle. Three silver-wire sutures were passed over the cord, uniting the muscle to Poupart's ligament. Two additional chromic gut sutures were passed above and below the silver sutures. The fascia was united with catgut, the skin with silk. On the left side a large ring was found and a considerable gap between the muscles and Poupart's ligament. These tissues were united over the cord with chromic sutures. Both wounds healed by primary union, and the man left the hospital July 11, 1907.

CASE XII.—Louis H., thirty years old, admitted July 5, 1907. The man had a congenital inguinal hernia on the right side, and a direct inguinal hernia on the left side. On the right side Ferguson's modification of the Bassini operation was done with chromic gut for the deep sutures. On the left side there was a direct hernia through the transversalis fascia. The upper half of the wound could be closed with chromic sutures, but below there would have been too much tension. Accordingly two sutures of silver wire were passed in the form of a filigree. The aponeurosis was united with catgut, the skin with silk. The wounds healed by primary union, and the patient went home on July 22.

CASE XIII.—Israel M., forty-five years old, admitted July 11, 1907. The man had had a right inguinal hernia for six months. The right ring admitted two fingers, and there was a bulging on coughing. The left ring also admitted two fingers, but there was no impulse on coughing. Operation July 12, 1907. Right side: A small sac found and tied off. Poupart's ligament was very thin. Two chromic sutures were used at the upper angle and four silver-wire sutures below them. Catgut was used for the aponeurosis, silk for the skin. Left side: No sac was found. The cord was buried by six chromic sutures. The man was discharged after a normal convalescence on July 29.

REMARKS.—Where the ring on the side opposite to a hernia is large we habitually close the ring at the time of operation, as we have found that many of these cases return a year or two later with a hernia on the opposite side, if this precaution is not taken. This step takes but a very few minutes, and we readily get the consent of both hospital and private patients when we explain to them the dangers of a subsequent hernia on the opposite side.

CASE XIV.—George N., eighteen years old, admitted July 22, 1907. In February, 1907, the man had been operated on for an infantile inguinal hernia. Soon after leaving the hospital he had noticed a recurrence. The writer had performed the original operation, using six No. 2 chromic sutures. The wound had healed by primary union, the temperature never exceeding 100° F. He had been kept in bed 14 days and had been in the hospital 20 days. On examination we found a reducible hernia. Operation July 24, 1907. A large sac was found which was dissected

from the surrounding tissues. Poupart's ligament was in such poor condition that it was out of the question to use it for a radical cure, so the fascia lata was exposed. The internal oblique muscle was sutured to Poupart's ligament and to the fascia lata by a running silver-wire cable suture. The aponeurosis of the external oblique was closed with catgut, the skin with silk. Time of operation, 35 minutes. The wound healed by primary union, and the man was discharged on August 8.

CASE XV.—Philip P., forty-two years old, admitted December 30, 1907. The man had been operated on twice for a left inguinal hernia, the first time at the German Hospital in Philadelphia, in 1905, and the second time at Mt. Sinai Hospital in the following year. The man stated that three months after his second operation the hernia had again recurred. It had always been easily reducible, and he had not worn a truss. The external ring was one and a half inches in diameter, and the hernia descended to the upper part of the scrotum. Operation, January 3, 1906. The sac contained omentum which was resected. Both the oblique muscles and Poupart's ligament were very poorly developed. The sac was excised. The cord was buried by several silver-wire cable sutures, uniting internal oblique and Poupart's. Chromic gut was used for the fascia and silk for the skin. The wound healed by primary intention.

CASE XVI.—Samuel M., twenty-three years old, admitted January 14, 1908. The man had a left inguinal hernia of three months' standing. The sac, as well as the contained omentum, were resected. Both the conjoined tendon and Poupart's were so poorly developed that the deep chromic gut sutures were reinforced by three silver-wire sutures. The fascia was closed with catgut, the skin with silk. Recovery was uneventful and the patient went home on February 5.

CASE XVII.—Nathan B., fifty years old, admitted January 23, 1908. Eight weeks before admission a left inguinal hernia developed. Five years before, after lifting a heavy weight, a hernia developed on the right side. Operation, January 27, 1908. On the right side a large hernial sac was excised. Bassini sutures of chromic gut were used, plain catgut for the fascia, and silk for the skin. On the left side a sliding hernia was found. The muscles were poorly developed, and accordingly silver wire was used for the deeper sutures. Otherwise the operation was done as on the right side.

REMARKS.—To-day the writer would be afraid to trust to chromic sutures in a case like this. He would use linen sutures on the right side, and silver sutures on the left side.

CASE XVIII.—Max S., thirty years old, admitted February 8, 1908. Three weeks before admission a left inguinal hernia was noticed. The inguinal ring barely admitted the tip of the index finger. Overlying Poupart's and almost as long as it, there was a mass which increased in size on coughing and which gave an impulse. The abdominal muscles in this region were thin, and at times it seemed as if there was a protrusion through them. Operation, February 10, 1908. The omentum in the left hernial sac was resected. Poupart's, except near the pubes, was absent and was replaced by a thin layer of muscular fibres. The cord, which was poorly developed, was buried by several chromic sutures, uniting the muscle to the crural fascia at the outer part, and several silver-wire sutures were used to sew the muscle to the periosteum of the pubes and also to Gimbernat's ligament. Cat-gut was used for the fascia and silk for the skin. Recovery was uneventful.

CASE XIX.—Koppel R., forty years old, admitted February 27, 1908. The patient had been operated on at Mount Sinai Hospital by another surgeon three months before his readmission. At that time he had stated that he had had a double inguinal hernia of three years' standing. It had always been possible to retain the herniæ with a double truss. The typical Bassini operation had been done on one side, and the Ferguson modification on the other. Chromic gut had been used for the deep sutures, and both wounds had healed by primary union. The man returned to the hospital, stating that five or six weeks after the operation he noticed, on coughing, a small protrusion on the right side. On the left side he had the feeling as if something protruded on coughing. On examination both rings were found enlarged, the right more than the left, and a small protrusion was felt on both sides, more on the right. Operation, March 3, 1908. Right side: A large opening was found at the centre of Poupart's, readily admitting a finger. There were no muscular attachments to the inner four-fifths of Poupart's, only a small slip of internal oblique was attached to the outer fifth. Four silver-wire cable sutures were used to unite the internal oblique and transversalis to Poupart's, the last one passing through the periosteum of the

pubis. The fascia was united with chromic gut, the skin with silk. Left side: The internal oblique was attached to Poupart's only over its outer half. The inner half was entirely free from muscular attachment. No hernial sac was found. A similar procedure to that done on the right side was carried out. Both wounds healed by primary union.

REMARKS.—A double recurrence in six weeks in a case like this, in which both wounds had healed by primary union and in which the operation had been performed *lege artis*, means one of two things: either the chromic sutures were absorbed too soon, or the knots of the sutures opened as the result of coughing or vomiting. The writer did not do the first operation in this case, but he has seen several similar cases done by different surgeons, and he has had one similar case of his own:

Bernard W., forty-two years old, admitted April 29, 1908. Two months before his admission to the hospital the man had been operated on at another hospital in this city for a double inguinal hernia. Shortly after his return home a recurrence took place on the left side. The man refused another operation.

Such cases (and they are not so rare) are a most potent argument in favor of using linen sutures.

The case is reported as being another early or rather immediate recurrence after the use of chromic gut. There had been no wound infection in this case.

CASE XX.—Nathan W., twenty years old, admitted August 4, 1908. In November, 1907, the writer operated on this man for a bilateral hernia. On the right side he had found a large sac, and on the left side a small one. Chromic gut had been used for the deeper sutures. With the exception of a slight superficial stitch-hole infection, convalescence was normal, and the man had left the hospital with both wounds healed two weeks after operation. On readmission the patient stated that immediately after he returned home he had noticed a small protrusion, which gradually increased in size, in the region of the scar on the left side. A month before his readmission he noticed a swelling on the right side, which rapidly increased in size, gradually working its way

down into the scrotum. On examination we found both herniæ easily reducible. Both inguinal rings admitted three finger-tips. Operation, August 7, 1908. Right side: The contents of the sac were reduced except one loop of gut broadly adherent to the sac at its neck. This was dissected free and the sac resected. The poorly developed conjoined tendon was sutured to the equally poorly developed Poupart's by a running silver-wire suture. Cat-gut was used for the aponeurosis and silk for the skin. Left side: After reducing the hernial contents the sac was resected. The conjoined tendon was fairly well developed, but Poupart's was very thin. A running silver-wire suture united these two structures. Both wounds healed kindly.

REMARKS.—As in the cases reported above, the chronic gut was evidently at fault, as the recurrence on one side took place immediately after the return home of the patient. It is interesting to note that both this case and Case XVIII were operated on in November, 1907. At that time our chronic gut was evidently too rapidly absorbed and allowed such early recurrences. In Case XIX we have the additional features of poorly developed Poupart's ligaments on both sides and poorly developed muscle in addition on the right side. Had this case been sutured with silver wire in the first instance, a recurrence would probably not have taken place.

CASE XXI.—Rebecca G., fifty-four years old, admitted August 8, 1908. The patient had had a double inguinal hernia from childhood. She had been operated on at a Newark hospital in 1905. Four weeks later a recurrence took place on both sides, larger on the left side than on the right. The left hernia steadily increased in size, with occasional symptoms of mild obstruction. On examination we found a large reducible left inguinal hernia with a ring that admitted three fingers. On the right side the ring was equally large, but the hernia was smaller than on the opposite side. Operation, August 10, 1908. Left side: The sac was adherent. All the contained small intestines were reduced except one loop which was adherent by a broad band at the bottom of the sac. This band was divided and the loop returned. The sac was then excised. The conjoined tendon was poorly developed. Poupart's ligament was flabby and showed

no evidence of having been sutured at the previous operation. With six silver-wire sutures the fairly well-developed rectus muscle was sutured to Poupart's, each suture taking as much as possible of the conjoined tendon. In this way both conjoined tendon and rectus muscle were used to close the canal. The external oblique was closed with catgut, the skin with silk. The patient did not want to have any operation done on the opposite side.

REMARKS.—Here again we probably have to deal with a case in which the chromic gut was absorbed too soon or the knots opened, and the patient had a double recurrence in four weeks. The muscle had been in contact with Poupart's for so short a time that at our operation, done three years later, no evidence of its having been sutured could be found. Such cases of very early recurrence after the use of chromic gut are not so rare as we have been led to think. The writer has seen enough of them at the hands of various surgeons to strengthen his conviction that linen is a far better suture material in hernia cases than chromic gut. In a hundred cases of hernia in which linen was used for the deeper sutures, the writer has as yet not seen a single recurrence. He does not mean to say that recurrences will not occur after the use of linen, but he does mean to say most emphatically that they will occur less often than when chromic gut is used.

CASE XXII.—Barbara G., thirty-eight years old, admitted January 2, 1909. The patient had been operated on for double inguinal hernia by another surgeon in 1904. Five weeks after the operation, which was done with chromic gut, a recurrence took place on the right side. The hernia had always been reducible after its recurrence, until one week before the patient came to the hospital. At that time the hernia became painful and irreducible. The day before operation vomiting set in. We found an irreducible right inguinal hernia as large as a plum. Attempts at taxis were unsuccessful. Operation, January 2, 1909. The hernia was reduced under anæsthesia. The sac was resected. Poupart's ligament was very poorly developed. Five sutures of silver-wire cable were used to unite the conjoined tendon to Poupart's over the cord. The fascia was sutured with

chromic gut, the skin with silk. The patient left the hospital on January 20, after an uneventful convalescence.

REMARKS.—We have here another immediate recurrence after a herniotomy, done by another surgeon with chromic gut. It is true there was an additional complication in this case, in a poorly developed Poupart's. But do not most surgeons use chromic gut in cases of this kind, even where the muscles and the ligament are poorly developed? Are such cases not much more suitable for linen or silver sutures?

CASE XXIII.—Anna J., twenty-six years old, admitted June 6, 1909. The patient was the sister of a physician. She had been operated upon by Murphy, of Chicago, for appendicitis in 1897. A large ventral hernia, partly reducible, had developed in the scar. Operation, June 17, 1909. The old scar was excised and the peritoneum was found adherent to the skin. The hernial opening was three inches long and two inches wide. By dissection the rectus muscle was exposed on the inner side and the retracted fascia and muscle on the outer side near the anterior superior spine. The incision was about seven inches long. Adhesions between the uterus and the anterior abdominal wall were divided. Two inflammatory cysts were removed from the left iliac fossa. The right tube and ovary had been removed with the appendix. Adhesions between the uterus and bladder were broken up and a piece of chromicized Cargile membrane placed between these two organs. The peritoneum was closed with chromic gut. The muscle and fascial flaps were dissected back far enough on either side to admit placing two silver-wire filigrees, each three by five inches, between the peritoneum (which had been sutured) and the fascia. Muscle and fascia were now sutured over this filigree but not approximated, except at the two angles (where there was no tension) with silver-wire sutures. The skin was closed with silk. The wound healed by primary union, and the patient was able to leave the hospital in two weeks. As this was a private case, we were able to follow it carefully. In spite of the large amount of silver wire employed in this case, the patient suffered no discomfort therefrom. The wound has remained solidly healed. We doubt very much whether we could have obtained as satisfactory a permanent result with any other suture material.

CASE XXIV.—Pauline D., twenty-five years old, admitted

March 29, 1909. Nine months before admission, after a difficult labor, an umbilical hernia developed. The hernia was easily reducible, though it was gradually increasing in size. The patient had endocarditis and nephritis; there was marked dyspnoea on exertion and frequent oedema of the feet. Operation, March 31, 1909. The abdominal wall was remarkably thin. The small sac was resected after the contained omentum had been replaced. Owing to the condition of the patient's heart and kidneys, we decided to do a rapid operation and avoid extensive dissection. The thin musculo-aponeurotic layer was broadly overlapped by a running suture of silver wire. The skin was closed with silk. After a normal convalescence the patient left the hospital on April 19.

CASE XXV.—Dora E., fifty-four years old, admitted May 31, 1909. This was a private patient who had an umbilical hernia of many years' standing. The hernia has increased in size with each pregnancy. It had been irreducible for several years, and at times very painful. On examination we found an irreducible umbilical hernia the size of a man's fist. The whole surface of the hernia was inflamed, and at the most prominent part there was an ulceration probably due to rubbing of the clothing. Operation, June 1, 1909. The ulcerated area was cauterized with carbolic acid, followed by alcohol. Omentum was found adherent in several pockets. The omentum and the sac were resected. The peritoneum was closed with chromic gut, the fascia was overlapped from side to side with silver-wire sutures. A slit rubber tube was placed at either angle of the wound. There was primary union of the wound. The patient was discharged in fifteen days.

CASE XXVI.—Nathan B., sixty-five years old, admitted September 27, 1909. The patient had worn a truss for twenty-five years for a right inguinal hernia. He had recently noticed a slight swelling in the left groin. We found a large irreducible scrotal hernia on the right side, and a small reducible inguinal hernia on the left side. Operation, September 29, 1909. Hernioplasty for hernia of bladder. A large sac was found on the right side, and closely adherent to it the urinary bladder, which had prolapsed through the inguinal canal. The bladder was separated from the sac without injuring it. The sac was opened and its contents reduced. The sac was then excised and the bladder returned to its normal position. The muscles were very much

atrophied from the many years' use of the truss. Bassini sutures of silver wire were used, the cord being buried. To reinforce a weak area in the muscles, a silver-wire filigree, one by three inches, was inserted. The fascia was sutured with chromic gut, the skin with silk. A postoperative hæmatoma in the tunica vaginalis broke down and caused a profuse purulent discharge. The patient left the hospital on October 27 with a sinus that has persisted, although the discharge has become very scanty.

CASE XXVII.—Max R., twenty-two years old, admitted February 12, 1910. The patient had been operated on by another surgeon in 1905. The abstract of his history at that time was as follows: "Since 1898 the patient had had a reducible right inguinal hernia. The right ring admits two fingers, the left ring the tip of the index finger. Operation, March 16, 1905. A typical Bassini operation was done on the right side. On the left side no sac was found and the internal oblique was sewed to Poupart's. Chromic gut was used on both sides. The left side healed by primary union, the right side became infected." From the time the patient left the hospital until six months before his readmission he was well. He then noticed a bulging in the left inguinal region, which was easily reducible. We found a small hernia in the scar on the left side, the side that had healed by primary union. The right side, in which there had been some infection, showed no evidence of recurrence. Operation, February 10, 1910. A left inguinal hernia was found with the sac adherent to the cord. The sac was resected, and the conjoined tendon sewed over the cord to Poupart's with five silver-wire sutures. Convalescence was uneventful.

CASE XXVIII.—Abraham A., fifty-one years old, admitted February 14, 1910. Two years before admission a right inguinal hernia had developed. This had gradually increased in size until walking had become almost impossible. We found a right scrotal hernia, as large as a cocoanut, consisting largely of gut, which was easily reduced. The ring was large and admitted three fingers. On the left side there was an incomplete indirect hernia, with a marked impulse on coughing. Operation, February 16, 1910. Left side: The sac contained omentum and small and large intestine. The contents were reduced and the sac resected. To close the canal five silver-wire sutures were used, and in between these several sutures of linen. Right side: A similar operation was done. The sac was not so large, and only five

silver-wire sutures were used to unite the conjoined tendon and Poupart's. Both wounds healed by primary union and the patient went home on March 17.

CASE XXIX.—Louis G., four years old, admitted February 26, 1910. The child had a congenital left inguinal hernia and undescended testis. The testis could be felt in the lower part of the inguinal canal, and could be brought down into the scrotum. The hernia was as large as an egg; it was easily reduced. The mother stated that another child in the family had a double congenital inguinal hernia. Operation, February 28, 1910. A fairly large sac was found. Both the oblique muscles and Poupart's were very poorly developed. On this account six silver-wire sutures and three linen sutures were used to join the conjoined tendon to Poupart's. We followed our usual technic and left the cord lying posterior to the suture line. The child left the hospital with a healed wound on March 19.

Hernias form so large a proportion of our surgical cases, and yet it would almost seem as if we did not give them as much thought and study as they deserve. We seem to have fallen into a rut these past ten years and do our herniotomies by rule of thumb. Is it not time to call a halt on the promiscuous use of chromic gut in herniotomies? Have we not been worshipping a fetich too long? It is true that we had unsatisfactory results with silk sutures. The knots irritated and often had to be removed. But this is not true with Pagenstecher linen. We can report a hundred cases, and in only one did we have to remove any sutures; and that in a case of fat necrosis, where catgut sutures would probably also have had to be removed.

The startling number of immediate recurrences after the Bassini operation with chromic gut, in which the original operation was done by various surgeons (and once by the writer) reported above, are surely worthy of serious consideration. They cannot be argued away. It is idle for a surgeon to say that this does not happen to him. The various surgeons that did the original operations in the cases reported above know nothing about these relapses. These cases happened to fall under the writer's care. As they came in close succession, they made a marked impression on him, and have

been the cause of his change of technic, both in regard to original operations for hernia and also in recurrent cases.

We are convinced that our results are much improved. There will surely be less recurrences, both early and late, with linen sutures than with chromic gut or kangaroo tendon. And is it not to be expected that we will have much better results in recurrent cases if we use silver wire instead of catgut? There is a very pleasant feeling of security in doing an important herniotomy, to know that our linen knots (especially if three knots are made) will never open as the result of coughing or vomiting. With catgut we are never sure. The same thing applies to the early absorption of the knot. That is unknown with linen sutures and happens not so seldom with catgut, to the chagrin of the surgeon and the disgust of the patient.

As regards the recurrent cases, the writer is more and more convinced, with increasing experience, that some form of silver wire is, in many of the cases, a very desirable suture material. This is especially true of the cases in which either the muscle or Poupart's or both are poorly developed. We firmly believe that in such cases catgut is entirely out of place for the deep sutures. In some recurrent cases, where the tissues are well developed, linen will be very satisfactory, but in many of these recurrent cases, the best results will be obtained with silver wire.

We have no desire to be dogmatic, but, from what we have seen at the hands of other surgeons and from the cases reported above, we have in our hernia work come to the following conclusions:

1. Chromic catgut is an unreliable suture material.
2. Pagenstecher linen is an excellent suture material.
3. Silver wire, in some form, is a very desirable suture material in many recurrent cases; and at primary operations where the tissues are poorly developed
4. Immediate recurrence, in uninfected cases, is usually due to chromic gut.
5. We will have fewer recurrences if we entirely discard chromic gut sutures.

A PNEUMATIC TOURNIQUET.*

BY FRANK E. BUNTS, M.D.,
OF CLEVELAND, O.

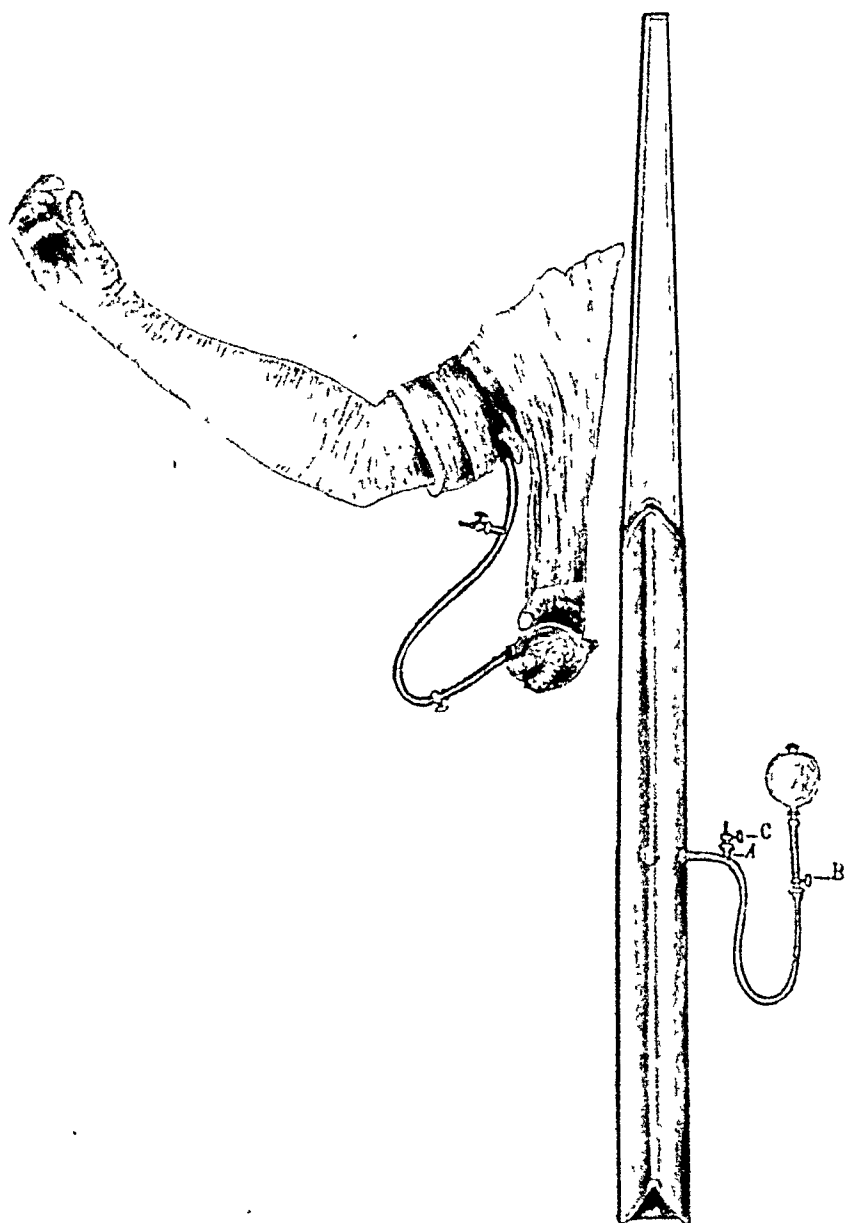
IN "Ashhurst's International Encyclopedia of Surgery" may be found an interesting account of the introduction of the tourniquet, which I venture to reproduce, viz.:

Next to the introduction of the ligature, the most important improvement in the operation of amputation was the invention of the tourniquet or "gripe-stick," as it was called by the English translator of Le Clerc. In its original form, this instrument, which was also known as the garrot or Spanish windlass, seems to have been devised about the same time (1674) by Morel, a French military surgeon, during the siege of Besançon, and by Young, of Plymouth, England, as described in his "*Currus Triumphalis e terebintho*," published in 1679. Morel's apparatus consisted of a thick compress, which was placed around the limb, and surrounded with a cord or small rope, under which were slipped two short sticks, by twisting which the cord was drawn very tight. Morel's tourniquet was improved by Le Dran and other surgeons by placing an additional pad immediately over the vessels and below the circular compress, by using only one stick for twisting the cord, and by placing beneath this a piece of paste-board—or, according to Garengéot, of horn or leather—so as to render the pressure on the skin less severe, and thus avoid the risk of sloughing, which sometimes followed the use of Morel's instrument. But the greatest improvement in the tourniquet was that made in 1718 by the illustrious J. L. Petit—le grand Petit, as he has been sometimes called to distinguish him from other less famous surgeons of the same name—and though, with its wooden plates and screw, we should think it but a rude contrivance, it was in all essential points the same instrument as the tourniquet employed at the present day.

Many other tourniquets have found their way into the armamentarium of the surgeon, such as Signoroni's, Lister's Cartes, Higgenbottom's, Tuffnell's, Skey's, and Esmarch's and their modifications. Some have had in view direct pressure upon the main artery of the limb but most have been, after all, but a slight improvement upon the garrot or Spanish

* Read in the Clinical and Pathological Section of the Cleveland Academy of Medicine, March 4, 1910.

FIG. 1.



The pneumatic tourniquet.

windlass. The one most commonly used is the Esmarch rubber band and chain or a simple rubber tube. These are certainly sufficient so far as controlling hemorrhage is concerned but are often so applied, either through ignorance, carelessness or perhaps unavoidably, as to cause very serious results, among which nerve palsy may particularly be mentioned. Thus when applied tightly above the elbow, musculospiral palsy may result and, if below the knee, peroneal nerve palsy sometimes follows.

In children particularly the need of some more suitable and more safely regulated pressure is manifest and, with this especially in view, I present for consideration a pneumatic tourniquet which, I think, will do away with some of the more obvious dangers of the older form of tourniquet.

In the *Medical News*, March 26, 1904, Dr. Harvey Cushing calls attention to a pneumatic tourniquet, which he had devised, based upon the well-known armlet of the Riva-Rocci blood-pressure apparatus and described as being a similar armlet though broader, of less distensible rubber and of such quality that it would stand boiling and, by connecting it with a bicycle pump of sufficient size, one or two quick strokes of the piston would fill it. This form of tourniquet has never become very popular, partly through lack of interest or information on the part of the profession, and partly because of the difficulty of keeping it from rolling when inflated and the necessity of a somewhat cumbersome apparatus (a bicycle pump) for its inflation.

I have devised an apparatus which is made of rubber and linen and consists virtually of two long rubber bags fastened together along their inner margins but connected at the middle by an opening through this fastening which permits the air to circulate simultaneously in both tubes when inflated. This obviates one of the greatest difficulties experienced in the construction of a practical pneumatic tourniquet. If it be made of a single rubber bag, the inflation will cause the superimposed turns of the tourniquet to roll off of each other and thus relieve the constriction. With the double tubes this cannot occur and it remains exactly where placed. The first one

constructed for me was made of pure rubber and enclosed in a linen bag to prevent its overdistention but, as it was somewhat inconvenient to remove it and replace it in the bag for cleansing or sterilizing purposes, I have had the present one made of much the same material as the familiar obstetrical pad, which is sufficiently elastic, very strong and durable and can be readily sterilized. It has a tapering end which, after the tourniquet is in place, is tucked under the inflatable part and becomes fixed as soon as pressure is applied. From the middle of one of the bags projects a rubber tube with an off-shoot, *A*, two stop-cocks, *B* and *C*, which permit respectively inflation by means of an attached bulb, and gradual diminution or total abolition of pressure by opening and allowing the escape of the air. If done slowly, undoubtedly venous engorgement would take place, but the inflation may be rapidly accomplished by a few pressures upon the bulb, and if still greater precaution against congestion is needed, the limb may be elevated or a Martin bandage applied before compressing with the tourniquet.

It can be applied uninflated to the limb prior to its preparation for operation and then, when needed, the circulation can be shut off by compression of the bulb without any disarrangement of the preparations about the field of operation. If, for any reason during the operation, it be desired to restore the circulation or to see whether the vessels have been secured, the air may be slowly allowed to escape by the anæsthetist or nurse by opening the stop-cock *C*, and controlled instantly by the re-inflation of the tourniquet, without having to readjust it. The advantage of this is apparent to any one who has been obliged to re-apply the ordinary tourniquet which has for any reason been removed when dressing the wound or at the close of an operation. The necessary disarrangement of towels and sheets and the pulling and jerking of the limb during this procedure are only too well known.

There are many practical applications of this tourniquet that suggest themselves, but it seems to me that one of the most beneficial would be its adoption by those engaged in the

ambulance service or wherever it may require application by those not skilled in the use of tourniquets in general or not familiar with their dangers. Where the amount of visible hemorrhage is the only indication, certainly there could be no excuse for the viciously tight tourniquets and Spanish windlasses that we only too commonly see applied. A smaller one could be readily made which might be used for operations upon the scalp or skull, and it might find a most useful application in replacing some of the more cumbersome forms of armlets used in blood-pressure apparatus.

THE CONTROL OF HEMORRHAGE BY MEANS OF FORCEPS-TOURNIQUET IN MAJOR AMPUTATIONS.

BY J. LYNN THOMAS, C.B., F.R.C.S.,

OF CARDIFF, ENGLAND,

Surgeon to the Cardiff Infirmary.

IT was in an article published in *The Lancet*, 23d of April, 1898, that I first suggested the method of controlling hemorrhage at the hip-joint by means of a pair of forceps similar in general form to those of Doyen's stomach-clamp. Since that time I have performed all my major amputations after the same fashion, and have neither used the Esmarch's, nor any other form of tourniquet, nor have I availed myself of the services of a trained assistant to control hemorrhage in cases where great authorities like Lister, Macewen, Syme, and others have recommended them.

The pattern of forceps-tourniquet which I now use and find most convenient is illustrated in Fig. 1.

The blades of the forceps are $6\frac{1}{2}$ inches long. For the purpose of description, I call the blade which is passed into the tissues, the *internal* blade; this is passed behind the blood-vessels and has a blunt point and is smooth and rounded in order to facilitate its passage through the tissues; at the same time to guard against the possibility of doing damage to blood-vessels or nerves against which it may impinge during its forcible passage.

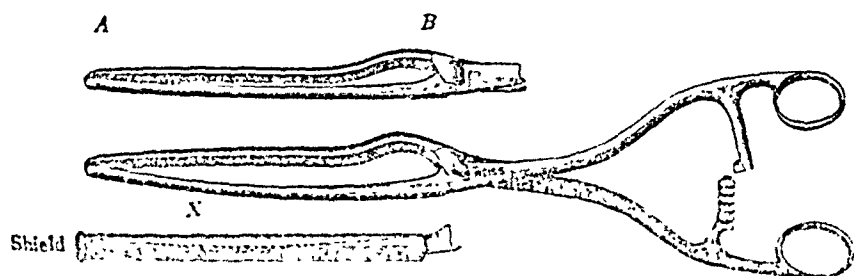
I have found the ordinary Doyen clamp to be positively dangerous for the purpose, on account of the point and the edge of a blade being often as keen as that of a knife edge. The *external* blade (*i.e.*, the one in contact with skin) is rough and serrated in order to prevent it slipping over the surface of the skin. The *shoulder* is made on this blade in order to avoid compression of the skin and underlying tissues when

the forceps is clamped on a muscular or fat limb, and also to prevent interference with the compression force of the far end of the forceps.

The principle of the method is that of simultaneous parallel compression of the blood-vessels (artery and vein) between the blades of the forceps; one blade (internal) being placed behind the blood-vessels to be controlled, and the other blade (external) being in contact with the skin.

In Fig. 2 is represented a transverse section through the hip-joint at a point where the internal blade of the forceps has been passed behind the blood-vessels and its external blade in contact with the skin.

FIG. 1.



A-B, $6\frac{1}{2}$ inches (six and a half inches). X, smallest diameter of internal blade. 14b measured by Cicero Smith's micrometer. Shield for carrying antiseptic jelly for the internal blade during military operations.

I will describe the method as originally employed at the hip-joint. A small stab puncture was made immediately below the anterior superior spine of the ilium, and through this the *internal* probe-pointed blade was pushed forcibly towards the neck of the femur, parallel with Poupart's ligament, and driven home as far as it would go. The limb was then elevated vertically for a couple of minutes in order to exsanguinate it, then the forceps was clamped; this action effectually and simultaneously compressed the common femoral artery and vein. After the anterior flap was made and turned up, the gaping blood-vessels were clamped by hæmostatic forceps and afterwards the forceps-tourniquet was released and withdrawn and was then passed behind the neck of the femur in order to control the blood-vessels in the posterior flap.

By this method the loss of blood during amputations of

the hip-joint has become practically negligible, and in quantity is not more than is always lost during amputation by any of the other so-called bloodless methods.

In 1904 I recorded a series of amputations which I had at that time performed successfully by this method of control of the main blood-vessels, and they included *three* at the hip, *five* interscapulothoracic, *seven* through the thigh, and others.

I then claimed that the mortality in amputations following this method of controlling hemorrhage was not more than that after any other method ever suggested. Since that time I have performed similar operations successfully, and in one case I have successfully removed the ilium in addition to the removal of the whole lower extremity.

The ages of my patients have ranged from infants to that of an old lady of eighty-four.

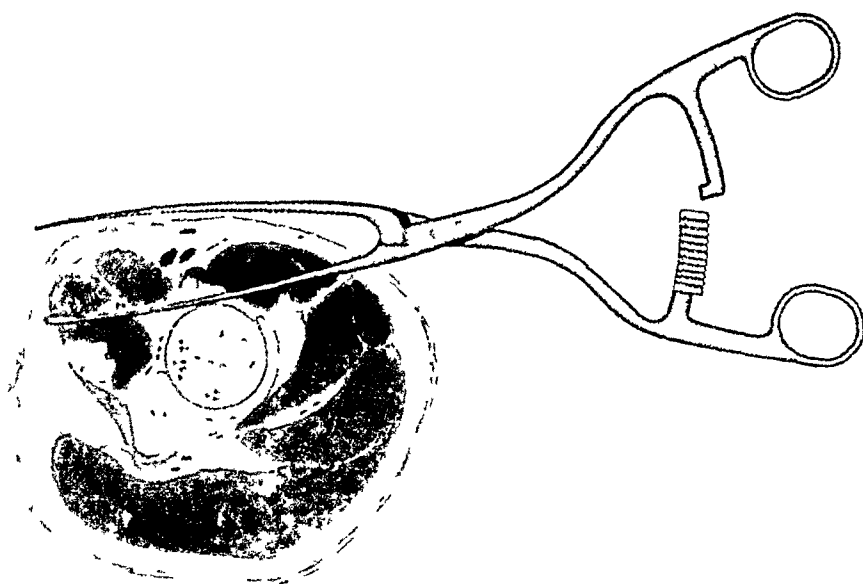
The method is simple, effective, reliable, and requires no assistant; the forceps-tourniquet is easily sterilized with the ordinary instruments, and during the operation it is entirely under the sole control of the operator.

It is not my intention to discuss the value of other methods of controlling hemorrhage, which are so well known to your readers, but I would invite my American confrères to give this method a trial, as I feel that it can be adopted without anxiety in the scrupulous requirements of modern aseptic or antiseptic surgery.

I believe that Dr. Charles Mayo was the first to use this method of controlling hemorrhage in the United States.

Note.—Since the above was written I am glad to find that Dr. Binnie in the second volume of his "Operative Surgery" refers to the method. Professor Kocher in Europe and Jacobson in England, and Thompson and Wiley in Scotland have already included in their well-known works my method amongst the recognized ones.

FIG. 2



• Section through hip joint showing method of controlling femoral vessels by forceps-tourniquet

FIG. 3

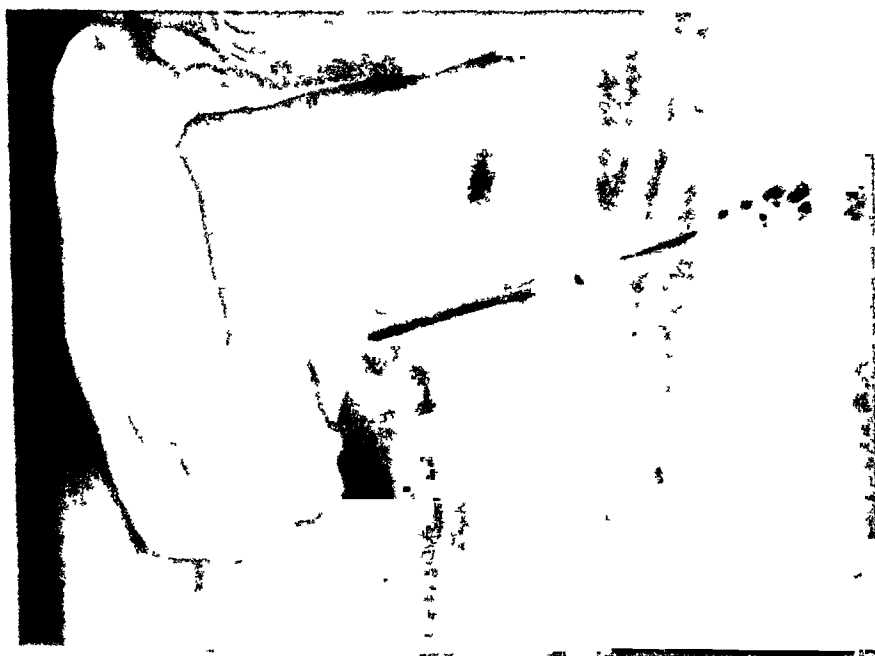


Fig. 3. Tumor of femoral vessels

FIGURES ABOUT FRACTURES AND REFRACTURES OF THE PATELLA.

BY EDRED M. CORNER, M.C.,

OF LONDON,

Surgeon to Out-patients and the Surgical Isolation Wards; Lecturer on Practical
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Hospital, Great Ormond Street.

THESE figures were compiled from the hospital annals for the purpose of a lecture.¹ As no similar figures have been adduced, it has been thought worthy to place them upon permanent record. The most important points which they show may be summarized as follows:

1. Fractures in the lower half of the patella are the most frequent, 83 per cent.

2. Triangular shaped patellæ are the most common; oblique shaped patellæ come next.

3. Transverse fractures are the most frequent; comminuted fractures come next.

4. Three males fracture their patella to one female.

5. Fractures of the right patella are a little more frequent than of the left.

6. Two underwent operation to every one which did not.

7. Fracture of the patella is most frequent between the ages of 30 to 40.

8. The patella is the most frequently refractured bone in the body.

9. After operation, 69 per cent. of refractures occur in the first year after the injury.

10. After treatment other than operation, 86 per cent. of refractures occur after the first year.

11. The percentage frequent of refractures is approximately the same after operative as it is after non-operative treatment.

¹ Delivered at the Policlinic.

12. The advantages of operation are solely in the quick and complete recovery of the function of the limb.

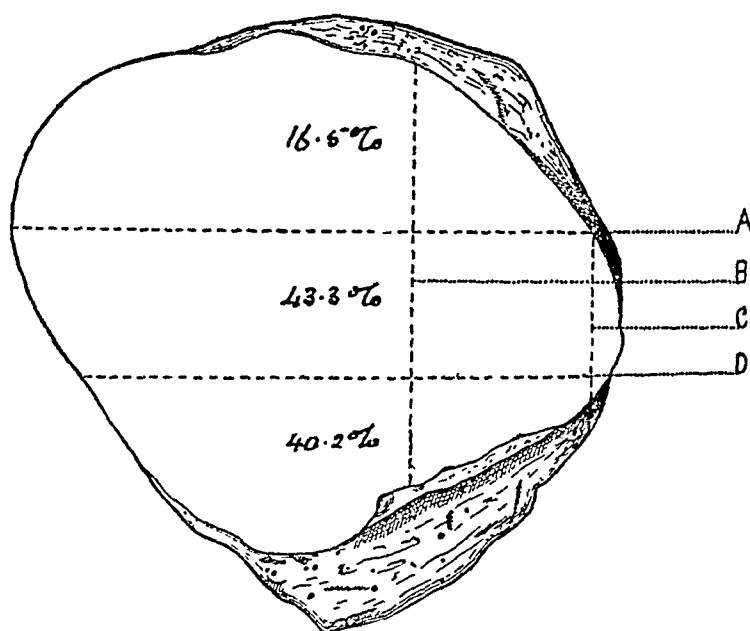


Diagram of the facets on the articular surface of the patella. *A* is the line marking the lower limit of the area in contact with the femur with full flexion of the knee. *D* is the line marking the upper limit of the area in contact with the femur in extension and slight flexion of the knee. *B* marks the division of the articular surface into right and left parts. *C* delimits the small area which is always in contact with the femur in all positions of the joint. The figures denote the percentages of fractures found in each area (see first table of figures).

STATISTICS OF CASES OF FRACTURE OF THE PATELLA ADMITTED TO ST. THOMAS'S HOSPITAL, 1890-1907 INCLUSIVELY.

Total number of cases, 504.

Fracture in lower part of bone	40.2 per cent.
Fracture about centre of bone	43.3 per cent.
Fracture in upper part of bone	16.5 per cent.
Fractures in lower part of bone	83.5 per cent.

Triangular shaped patellæ	66 per cent. ²
Oblique shaped patellæ	20 per cent.
Elliptical shaped patellæ	9 per cent.
Circular shaped patellæ	5 per cent.

Transverse fractures	85 per cent.
Oblique fractures	4 per cent.
Comminuted fractures	10 per cent.
Compound fractures	1 per cent.

²Proceeding of Anatomical Society, February, 1900, pp. xxvii and xxviii.

In male subjects	73	per cent.
In female subjects	27	per cent.
On right side	55	per cent.
On left side	44	per cent.
Bilateral	1	per cent.
Patella sutured	65	per cent.
Treated by splints and massage	35	per cent.

Earliest period of life in which fracture occurred....between 5-10 years.
 Period at which fracture occurs most frequently....between 30-40 years.
 Next period at which fracture occurs most frequently.between 40-50 years.
 Latest period in which fracture occurred.....between 70-80 years.

STATISTICS OF REFRACTURE OF THE PATELLA.

Total number of cases, 55.

Frequency of refracture	11	per cent.
Frequency of fracture of other patella.....	1	per cent.
Frequency of refracture after suture of the fragments	10	per cent.
Frequency of refracture after other treatment..	9	per cent.
In male subjects	84	per cent.
In female subjects	16	per cent.
Of right patella	56	per cent.
Of left patella	44	per cent.
Bone twice fractured	85	per cent.
Bone three times fractured.....	9	per cent.
Bone four times fractured.....	6	per cent.
Compound refractures	7	per cent.
After suture, percentage of refractures within the first year	69	per cent.
After the first year.....	31	per cent.
After the first 3 years.....	12	per cent.
Within the first 3 years.....	88	per cent.
After other treatment, percentage of refrac- tures within the first year.....	14	per cent.
After the first year.....	86	per cent.
Refracture occurring through the same place as the former fracture.....	95	per cent.
Otherwise the refracture is above the line of the original fracture.		

TRANSACTIONS

OF THE

NEW YORK ACADEMY OF SURGERY.

Stated Meeting, held May 11, 1910.

The President, DR. ELLSWORTH ELIOT, JR., in the Chair.

THREE CONSECUTIVE TRANSFUSIONS FOR PROFOUND SECONDARY ANÆMIA.

DR. E. H. POOL presented a woman, 43 years old, who was admitted to the French Hospital on December 29, 1909. The following were the significant points of her history: Two weeks before admission she had suffered from violent headaches, pain in the back, and extreme weakness; a day later, slight jaundice appeared. She was confined to bed from the onset of her illness, growing steadily worse. For a number of years past she had at times suffered from a distressing cough and dyspnœa. Eighteen months ago she began to lose color, and this pallor had gradually become more pronounced. Menstruation had always been profuse, making her weak for some time following; the menorrhagia had been especially marked recently. She had two children, living and well; no miscarriages. Her habits were good.

Physical examination on admission: The patient was aroused with difficulty. Her mucous membranes were colorless, the lips dry, parched and brown; the conjunctivæ were slightly yellow; the skin had a lemon tint and was bloodless. The radial pulse was imperceptible and the heart sounds were very feeble. The woman appeared to be moribund. A blood examination showed 600,000 red blood-cells and 16 per cent. hæmoglobin. The urine contained a trace of albumin, abundant red blood-cells, a few leucocytes and hyaline and granular casts.

Transfusion by the Carrel suture method was immediately done, taking the woman's husband as donor, although he was weak and anæmic, his hæmoglobin being 70 per cent. Following

this there was some improvement in her condition, but the hæmoglobin rose only to 22 per cent. Blood examination that evening and on several subsequent occasions suggested pernicious anæmia.

The next day a second transfusion was made, taking a young man as donor. This was followed by marked improvement. The patient's cheeks became flushed, and her lips resumed a normal color. She, however, became extremely restless, and it was necessary to stop. During this transfusion, the patient's hæmoglobin rose to .33 per cent., and the number of red cells to 2,000,000. Afterwards she became delirious and two days later showed extreme jaundice.

Ten days later a third transfusion was done, as the patient's blood and general condition showed a marked tendency to become worse. A healthy young man was taken as the donor. Considerable and prolonged improvement followed this operation, the hæmoglobin rising from 23 per cent. to 56 per cent. during the transfusion.

After the third transfusion, the patient's blood continued to improve, although she developed a pneumonia in the right lower lobe, and subsequently pleurisy with effusion on the left side. Dr. N. B. Potter took charge of the patient during this illness, and made sixteen aspirations, removing from 20 to 30 ounces of clear or blood-tinged fluid each time.

The patient was now in good health, with 70 per cent. of hæmoglobin and over 3,000,000 red blood-cells. The blood examination was otherwise negative; the urine contained a trace of albumin.

According to Dr. Potter and Dr. F. C. Wood, the blood picture was not one of typical pernicious anæmia, but rather of very marked secondary anæmia, with a persistently high color index.

CARCINOMA OF AN ACCESSORY THYROID.

Dr. POOL presented a woman, 46 years old, who was admitted to the service of Dr. Frank Hartley, at the New York Hospital, on April 8, 1910. Three years ago she first noticed a small lump on the left side of the neck which had gradually increased in size. It was never painful. Last summer she began to have stinging pains of great severity in the left shoulder, and recently these pains had extended to the left arm. They had gradually been growing more severe, and three days before admission she

began to have constant pains of the same character in her left hand and wrist. She had lost about thirty pounds in weight in the past year.

Physical examination: The patient was a well-developed woman. She complained of slight stiffness and pain on moving the neck. On the left side, corresponding approximately to the lower two-thirds of the sternomastoid muscle, there was a swelling about three and a half inches in diameter. The skin covering this was movable and normal in appearance. The swelling, which lay in part beneath the sternomastoid muscle, was hard, slightly nodular, and somewhat movable, but did not move during deglutition (Fig. 1). The pulsation of a large vessel could be felt mesial to its upper limit. In the left arm, the grip was relatively weak, but there was no paralysis nor anæsthesia. Eyes, respiration, voice and deglutition were normal.

Operation, by Dr. Frank Hartley: The mass was exposed by an incision along the anterior margin of the sternomastoid. The internal jugular crossed it vertically, and was ligated above and below; the omohyoid also crossed it, and was cut. The mass was then readily enucleated, after ligating several large nutrient vessels. The carotid lay posterior to the growth, the sternohyoid and sternothyroid mesial. On lifting these, the whole of an apparently normal thyroid gland, with isthmus and pyramidal lobe, was exposed. The patient made an uneventful operative recovery.

Report of specimen, made by Dr. Elser, Pathologist to the New York Hospital. The specimen consisted of an aberrant thyroid gland, oval in shape, measuring 9.5 cm. in length, 5.5 cm. in breadth and 5 cm. in thickness. The mass was covered on the outside by filmy connective-tissue membrane, through which numerous large, vascular channels were dispersed. Projecting beneath this capsule were many irregularly outlined, yellowish nodules. The mass was quite firm in consistence. On section, the cut surface was diffusely brownish-yellow in color, and irregularly lobulated. At one pole of the mass was a large area of necrosis. The specimen was accompanied by half a dozen enlarged lymph-nodes; most of these were yellowish-brown in color and were surrounded on the outside by connective-tissue capsules. On section, the cut surface was moderately granular, yellowish in color and elastic in consistence.

Microscopical examination of the accessory thyroid revealed the typical histology and papillary adenocarcinoma. Microscopical examination of the lymph-nodes revealed extensive metastatic deposits. Practically all the lymphoid tissue had been replaced by tumor growth.

FIG 1.



Carcinoma of accessory thyroid



PARTIAL THYROIDECTOMY FOR EXOPHTHALMIC GOITRE.

DR. WILLY MEYER presented a man, 36 years old, who came to the German Hospital early in 1910 with all the signs of typical exophthalmic goitre, and gave a history which dated back five years. During the past eighteen months his symptoms had become more pronounced; there was dizziness, rapid pulse and marked exophthalmus. He was first treated with the serum prepared by Merck, antithyroidin, in comparatively large doses. A week or ten days later the entire thyroid gland was exposed through a transverse incision, with the intention of removing the right lobe. There was still profuse hemorrhage after the right thyroid arteries had been tied; this was immediately checked after crushing and ligation of the isthmus, which was much enlarged. About one-third of the gland was left.

The patient made a rapid recovery, and a few weeks after the operation it was found that his pulse had materially improved, the exophthalmus was less pronounced and his other symptoms had disappeared. His highest temperature following the operation was 102.8, and this rapidly subsided.

CASES ILLUSTRATING THE EFFECT OF ARTIFICIAL ARTERIAL HYPERÆMIA IN THREATENING GANGRENE OF THE FOOT, DUE TO DIABETIC ENDARTERITIS.

DR. WILLY MEYER showed these cases. The first patient was a man, 60 years old, diabetic, on whom he did an amputation of the thigh in January, 1907, for dry, rapidly spreading gangrene of the toes and foot. The operation was done under spinal anesthesia, and with secondary suture of the wound.

About a year and a half later this patient began to show evidences of beginning gangrene of the opposite foot; several toes became affected, and as the man absolutely refused further operative interference, it was decided to try artificial arterial hyperæmia. A suitable hot air apparatus was thereupon provided, and under this method of treatment, which had been faithfully carried out since, the gangrenous process affecting his remaining foot had been overcome. Not one part of the toes necrosed. Two apparatuses were used, alternately daily, one for the thigh and leg with high temperatures, the other for the affected foot with lower

temperatures, inasmuch as the affected part cannot stand great heat.

Dr. Meyer's second patient was a man, also 60 years old. The case was one of beginning diabetic gangrene involving the toes of both feet, with some œdema and threatening pains that indicated an extension of the process. A properly fitting hot air apparatus was provided, in which the upper and lower portions of the extremities were alternately exposed to a very high temperature. The result of this treatment was beyond expectations. The threatening gangrene failed to extend, the bluish discoloration of the toes disappeared, the patient had remained in comparatively good health and was able to go about without the aid of a stick or other support. He had now been using this apparatus daily for the past seven months, and the treatment was still being faithfully carried out.

As a matter of fact, this treatment will be successful in a certain number of cases only. Still it means an addition to our therapeutic resources, and deserves further trial. It is not indicated in the moist form of gangrene.

He had tried it also in two cases of Raynaud's disease. In one it had a temporary effect only, in the other none at all.

DR. HOWARD LILIENTHAL said that the results of the hot-air treatment in these cases were certainly wonderful, and personally he had never seen anything like it. He inquired whether in the last case shown there was any pulsation in the posterior tibial, and also how long these patients continued the exposure to the hot air at each session. Also, what sort of apparatus he had been using, and how long he would advise the continuance of the treatment? The first case was apparently one of thrombo-angitis obliterans, in which the speaker said he had always advised amputation, whether the gangrene was of the dry form or not.

DR. MEYER said that both the patients were diabetics. The hot-air exposures were at first limited to a fraction of one hour at each sitting, but the time was gradually lengthened to a whole hour daily. For the purpose of heating the apparatus, electricity was much superior to the Bunsen burner, as with the former there was no odor and there was no danger of fire or explosion. He warned against the use of alcohol as a means of heating the apparatus, and he recalled one case at the German Hospital where the alcohol lamp had set fire to the blankets covering the leg.

The treatment should be continued by the patients themselves—perhaps with longer or shorter intermissions—as long as they lived.

THE FIRST CASE OF THORACOTOMY IN A HUMAN BEING
UNDER ANÆSTHESIA BY INTRATRACHEAL
INSUFFLATION.

DR. HOWARD LILIENTHAL presented this patient, with full description of his condition, for which see *ANNALS OF SURGERY* for July, page 30.

CLINICAL EXPERIENCE WITH INTRATRACHEAL INSUFFLA-
TION (MELTZER), WITH REMARKS UPON THE VALUE
OF THE METHOD FOR THORACIC SURGERY.

DR. CHARLES A. ELSBERG read a paper with the above title, for which see *ANNALS OF SURGERY* for July, page 23.

DR. WILLY MEYER said that he was firmly convinced that in the course of time we would not depend on any single method in the performance of intrathoracic operations, and if this apparatus for intratracheal insufflation, which was less expensive than the differential pressure cabinets, was shown to work as well in human beings as in animals, we could look forward to its more general employment with much satisfaction as an addition to our mechanical resources in thoracic operations. The differential pressure cabinet and chamber had its field of usefulness in the large hospitals, where no doubt intrathoracic surgery would soon be undertaken by many surgeons.

Dr. Meyer said he had several times occasion to go deeply into the literature of thoracic surgery, and he had found that in 1896 Professor Tuffier, of Paris, had introduced a metal tube through the larynx deep into the trachea for anæsthesia, compressed the trachea above with a special clamp, and in this manner succeeded in narcotizing a patient and successfully doing a resection of the lung. This seemed to be the first case of intratracheal anæsthesia in the human. It was surprising that Tuffier did not continue his successful experiments. Two years later, Dr. Parham, of New Orleans, an associate of Dr. Matas, did a resection of the chest wall for the removal of a malignant growth. To anæsthetize the patient, he employed a Fell-O'Dwyer tube of a special conformation and just long enough to dip into the

trachea. By this means he successfully removed the growth. Here also intratracheal anæsthesia was helpful in completing the operation.

Regarding the patient presented by Dr. Lilienthal, he suggested that some artificial pneumothorax was left unintentionally when closing the thorax. The air in the pleural cavity first compressed the lung and reduced the size of the abscess cavity or cavities. With increasing absorption and attenuation of the component gases of the air the cavities again distended and the cough with expectoration returned.

DR. S. J. MELTZER said that in his earlier experiments with the intratracheal insufflation method the pressure of the air current before entering the trachea was, as Dr. Elsberg had pointed out, limited to a variation from ten to twenty mm. of mercury, but his more recent investigations had shown that the degree of this pressure had very little significance so long as the intratracheal tube was not too large to permit the free return of air. For example, it was found that an external pressure of 25 mm. produced in the trachea and bronchi a pressure of only 5 mm., and that a sudden increase of the external pressure to 50 mm. raised the pressures of the bronchi and trachea only 1 mm. of mercury.

This method of intratracheal insufflation, Dr. Meltzer said, was now being experimented with as a means of saving life in strychnine poisoning. In control experiments it was established that four-tenths of a milligramme of strychnine given to a dog by intravenous injection resulted fatally within 45 minutes. Eighteen dogs, which received eight-tenths of a milligramme of strychnine by intravenous injection, that is, twice the fatal dose, were kept alive and completely recovered by the aid of the intratracheal insufflation, which was kept up continuously in some cases as long as eight or nine hours. The convulsive movements were controlled by curarin and injections of Ringer solution were given to hasten the elimination of the strychnine by the kidneys. At the subsequent autopsies of these animals, there was not the slightest evidence of an injury to the trachea or lungs.

DR. N. W. GREEN thought that Dr. Meltzer deserved especial credit for developing this method of intratracheal insufflation for intrathoracic work, for which so many other similar methods had been ineffectually tried. In this connection, it may be inter-

esting to note that a case was reported by Chaussier in 1781, in which he used an intralaryngeal canula to resuscitate a young man said to have been in the last stages of phthisis. This case was reported before the Royal Society of Medicine, Paris.

DR. LILIENTHAL said that in the case of thoracotomy he had reported, while there were quite a number of adhesions between the visceral and parietal pleuræ, these did not impede the motions of the lungs to the slightest degree. He had made no attempt to loosen these adhesions. The lung was blown up to its fullest capacity before closing the chest, and the wound was then covered with moistened gauze.

DR. ELSBERG, in closing the discussion, emphasized the fact that the method of Dr. Meltzer differed absolutely in principle from that of the previous intratracheal methods. All of the methods that had been formerly advocated consisted essentially of the introduction of a tube into the trachea, which closed about the tube. By Dr. Meltzer's method, the tube was introduced almost down to the bifurcation, and it was so small that it permitted the free escape of air. With this method, it made no difference whether the patient breathed or not, whereas with the positive or negative cabinet it was very essential that the patient should not stop breathing.

BOOK REVIEWS.

DISEASES OF THE STOMACH AND INTESTINES. By ROBERT COLEMAN KEMP, M.D., Professor of Gastro-intestinal Diseases in the New York School of Clinical Medicine. 8vo, pages 710, illustrations 280. W. B. Saunders Company, Philadelphia and London, 1910.

The study of gastro-intestinal diseases is at the present date in an active transitional state. This is due mainly to the fact that in some instances, lamentably few we must confess, the clinician is confirming his diagnosis through means of the surgeon and the living pathology of the operating table. This is much more important in its results, both immediate and remote, as far as the welfare of the patient is concerned, than that information which we have hitherto acquired through the agency of the post-mortem.

What, then, have been the results? The answer is short, but yet revolutionary in its significance. Briefly it indicates that chapter after chapter of books which we have heretofore accepted as standard must be so altered and revised that the identity of the old ones will be completely lost. The treatise on diseases of the stomach in the future will decrease rather than increase in volume. What is needed and what will be produced is a work on *practical gastro-enterology*.

Can the general practitioner, or indeed the stomach specialist, be made to appreciate that in a thousand consecutive cases applying to him for relief of gastric symptoms, in less than 10 per cent. will the trouble be found in the stomach? In the other nine hundred cases he must look for, identify, and treat the etiologic factor, he must minister to the house that is burning, and not to the central station from which the alarm was sent out.

The author prefaces the present volume by remarking that in view of the excellent works on diseases of the stomach and intestines already placed before the profession, a new book on these subjects might seem superfluous. In considering the above facts and the large experience of the author, such a conclusion,

I am sure, will not be reached by his colleagues. The book considers so many phases of subjects which form the borderland between medicine and surgery, that it is alike of extreme interest to both practitioner and surgeon.

Its general scope covers all of the disorders, both subjectively and objectively, which one is liable to meet. The author is definite in stating his own conclusions, but does not belittle others by omitting them, leaving the question in many instances to the reader to draw his own inferences. The specific treatment and general management of the various conditions are thoroughly indicated.

Critically considered, we deplore the introduction of such illustrations as Turck's gyromele, Einhorn's radiodiaphane, the stomach whistle, and similar apparatus, with their accompanying text. Their uselessness, if not danger, has long since been demonstrated, and I am sure the value of the book would not be lessened by their being omitted.

In general, the author has brought up to date the knowledge of the subject as prescribed by the field indicated in the title, and as a record of personal experience and contemporary achievement will form an addition to our appreciation of the realms of gastro-enterology.

FRACTURES AND DISLOCATIONS. By LEWIS A. STIMSON, B.A., M.D., Professor of Surgery in Cornell University Medical College, New York. Sixth edition, thoroughly revised. Octavo, 876 pages, with 361 engravings and 65 plates. Lea and Febiger, Philadelphia and New York, 1910.

This treatise, which is now in its sixth edition, has been repeatedly reviewed in the *ANNALS OF SURGERY*, and it is not necessary to mention again the character of the work. The present edition is encyclopædic in its scope as far as fractures and dislocations are concerned, and cosmopolitan in the knowledge presented, owing to the inclusion of the accepted views of specialists throughout the world.

In this edition the author has enlarged our knowledge principally as regards the injuries of the small bones of the carpus and tarsus, and includes a new subhead, "The Midcarpal Frac-

ture-dislocations," the recognition of which has come mainly through investigations stimulated and aided by X-ray examinations. Sections have also been added on fractures of the floor of the acetabulum and of the internal epicondyle of the femur, and on backward dislocation of the lower jaw. Other additions of importance relate to treatment. Under this subject we find no reference made to the employment of metal plates for the correction of deformities in the long bones, as advocated by Lane.

Although the medical practitioner is loath to assume the responsibility of a complicated fracture, those who are situated far from the great centres must assume this responsibility, however limited may be their experience. To these men this book especially appeals as being a most complete, conscientious, and satisfactory treatise.

JAMES T. PILCHER.

CORRESPONDENCE.

ALBA'S OPERATION.

IN the report of the proceedings of the New York Surgical Society in the ANNALS OF SURGERY, vol. lii, No. 6, pages 938, 939, in describing the operation for rheumatoid arthritis of the hip the text calls it "Abbe's operation." It should be Alba's (Dr. F. H. Alba).

H. M. LYLE.

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ORIGINAL MEMOIRS.

THE TREATMENT OF SCALPING ACCIDENTS.*

REPORT OF TWO CASES OF SCALPING BY MACHINERY, WITH A CONSIDERATION
OF SCALPING ACCIDENTS IN GENERAL.

BY JOHN STAIGE DAVIS, M.D.

OF BALTIMORE, MD.,

Instructor in Surgery, Johns Hopkins University; Assistant Surgeon Out-Patient
Department, Johns Hopkins Hospital.

In text-books and systems of surgery scalping is generally considered under "Lacerated Wounds of the Scalp," but it is undoubtedly a lesion whose treatment requires much more careful study and attention than is usually accorded it.

This paper is based upon a critical review of the literature, my own experimental work, and on two cases of complete scalping, which were healed by skin transplantation. On one of these cases, that of Dr. Bloodgood's, Thiersch grafts only were used, while on the other, which was my own, the healing was brought about entirely by whole thickness grafts.

I take this opportunity of thanking Dr. Halsted for the use of the cases from his clinic, reported in this paper, and also Drs. Cone, Porter, Roberts, and Spencer for allowing me to include in my series their unpublished cases of complete scalping.

REPORT OF TWO UNPUBLISHED CASES.

CASE I (Dr. J. C. Bloodgood).—Admitted to the Church Home and Infirmary on August 24, 1906. Diagnosis: complete

* The full text of this paper with detailed case reports, bibliography, etc., will appear in vol. xvi of the Johns Hopkins Hospital Reports.

scalping by machinery. Treatment: grafting with Thiersch grafts. Result: recovery.

Clinical History.—White, female, aged 41 years, operator in a canning factory.

Family and Personal History.—Unimportant.

Physical Examination.—This was negative, except as noted below.

Present Illness.—On August 21, 1906, the patient caught her hair on a rapidly revolving shaft, which was directly over her head, and was completely scalped. The line of tearing included both eyebrows and extended backwards, just above the ears, to below the hair line on the neck. There was some laceration of the right ear and several periosteal defects, but no other injury. There was no loss of consciousness, but the pain was very severe. The hemorrhage was marked. No attempt was made to replace the scalp.

On admission to the hospital the patient was in a fairly good physical condition. Red blood-corpuscles 4,400,000, hæmoglobin 80 per cent. She was suffering considerable pain. The head was dressed with wet salt solution dressings, and the eyes were irrigated with boric solution.

September 13, 1906: The growth of the granulations was exceedingly slow, but in spite of this it was decided to graft. Large Thiersch grafts, obtained from a young woman, 19 years old, were applied by Dr. Follis. The result was total failure, which was probably due to the unsatisfactory condition of the granulation tissue.

By the use of the following technic good healthy granulations were produced. A single layer of dry gauze was placed over the wound, and this was covered with rubber protective. This dressing was changed every other day. The granulations were stimulated by the gauze and were held flat by means of the protective. In about two months the granulations were in excellent condition and there was a growth of epithelium one-fourth of an inch wide around the edges of the wound.

November 15, 1906: Operation, Dr. Bloodgood, assisted by Dr. Follis; ether anæsthesia. The entire granulating surface was swabbed with pure carbolic acid followed by alcohol. The left half of the wound was freely scarified with a knife and, after the hemorrhage was checked, was covered with large autodermic Thiersch grafts. The grafts were dressed with silver foil, over

which was placed collodion and little strips of gauze, then more collodion, silver foil, and more gauze. The ungrafted portion of the head was covered with boric ointment, collodion, foil, and gauze, completing the cap, which was held snug by straps of adhesive plaster. Practically all of these grafts were successful.

December 6, 1906: The right half of the head was prepared, grafted, and dressed in a similar manner, with equally good results. The grafts were cut by the modified Thiersch method used at the Johns Hopkins Hospital.

Ulcerations appeared here and there on the grafted area, but these soon healed. The patient was discharged on March 8, 1907, with the newly grafted area in excellent condition (Fig. 1).

Examination of the Patient on March 17, 1910.—The head was covered with a smooth, thin, shiny, movable skin, in which could be seen numerous blood-vessels. On the vertex were five or six small ulcerations, the largest being about the size of a ten-cent piece. These ulcers were sometimes painful. She said that small ulcerations had occurred from time to time ever since leaving the hospital.

There was normal sensation over practically the entire grafted area. There was no retraction of the eyebrows and the eyelids could be closed normally. The patient was continually bothered by the sensation of a heavy weight pressing on the top of her head, and she said that she could not lean over without a feeling of great tightness in the same area.

CASE II.—The case described below was referred to me for treatment through Dr. J. M. T. Finney. The history before the patient came under my care was obtained partly from the family physician, Dr. A. H. Montgomery, of Montgomery, Alabama, and partly from the patient herself.

On July 29, 1907, Miss X caught her hair on a rapidly revolving shaft under which she had inadvertently walked. The shaft was above her and on her left side. She was lifted up and when the scalp gave way she fell back to the floor. There was little immediate pain but the hemorrhage was profuse, although of short duration. There was no loss of consciousness. She did not realize that the scalp was gone until she put her hand to her head.

Examination showed that the scalp had been torn off from the hair line in front to the hair line behind, including the entire occipitofrontalis muscle, and the line of tearing extended from immediately above the right ear to below and including the left

ear, and also an area of skin on the cheek below and in front of it. The skin of the forehead was hanging down over the eyes. This was sutured to the periosteum and the wound cleaned as well as possible. Three bleeding points were tied. There was a defect in the periosteum in the left frontoparietal region. No other injury was found. No attempt was made to replace the scalp. The head was dressed with rubber tissue and sterile gauze.

There was very little pain on the night of the accident, but on the day following and continuing for two weeks the suffering caused by the dressings was very severe. The pain was localized in two spots just below the superior curved line of the occipital bone about one inch from the middle line on each side, and there was also a sensation of strong pulling.

Six weeks later skin was taken from her thighs after the method of Thiersch and was placed on the front part of the wound, on the lobe of the left ear and on the triangular space below it. The result of this grafting was not satisfactory. No further grafting was attempted until the following year.

On August 13, 1908, after careful preparation, Thiersch grafts from a lamb were applied. In September strips of whole thickness lamb skin were transplanted. About one month later guinea-pig skin was used, and two months later lamb skin was again tried. All of the grafts were placed on the periosteum following the removal of the granulations, and all were unsuccessful.

The patient came under my care on May 1, 1909, and was admitted to the Union Protestant Infirmary on that date.

Diagnosis: granulating wound following complete scalping by machinery. Treatment: grafting with whole thickness sessile skin flaps. Result: recovery.

Clinical History.—White, female, aged 24 years, milliner.

Personal and Family History.—Unimportant.

Physical Examination.—This was negative, except as noted below.

When the dressing was removed a mass of fungating gelatinous granulations, which bled easily, was exposed. These were very exuberant and the entire mass could be moved by resting the hand on the vertex and gently making excursions from side to side. This area measured in the middle line from front to back 23 cm., and from ear to ear 28 cm. It was surrounded by a cicatrizing border about 1 cm. in width. The left ear was

lacking except for a small part of the lobe. The outline of the ulcer can be well made out in Fig. 2, taken three weeks after admission.

May 1 to May 28: The wound was thoroughly cleaned. The patient was put on forced feeding and tonics, and also was required to live and sleep out of doors, in order to secure the best physical condition.

Within a short time, following the free use of nitrate of silver stick and tincture of iodine, the character of the granulations decidedly changed. After these applications the patient was placed in the sunshine, which was allowed to fall directly on the granulating area. The time of this exposure varied from half an hour at first to the entire day. After the exposure the wound was dressed with balsam of Peru, 2 parts, and castor oil, 6 parts, on an adjustable cap (Figs. 3 and 4).¹ There was no pain whatever connected with these dressings.

I decided to use only whole thickness grafts in order to get a more lasting, durable healing.

June 3: Whole thickness grafts 20 x 4.5 cm. were removed from each thigh, after blocking the external cutaneous nerves.

June 15: Whole thickness grafts 16 cm. long by 7 cm. wide were taken from both sides of the lax abdominal skin, under local anæsthesia with Schleich's solution. All of these flaps were removed with the subcutaneous fat, and dry technic was carefully observed throughout. The fat was removed and the flaps were freely button-holed and placed on undisturbed granulations. Over the grafts, and overlapping the healthy skin and uncovered granulating areas, rubber impregnated mesh was placed. The ends were twisted and secured by adhesive plaster. The grafts were dressed with normal salt solution for 48 hours. The mesh was kept in place for about one week. All of these grafts were successful (Fig. 5).

June 24: Several large pieces of whole thickness skin, obtained from a ventral hernia case, were applied six hours after removal. This skin had been chemically cleansed and a large part of it was scar tissue. It was treated and dressed in the usual manner. These grafts seemed to take throughout, but later a considerable portion sloughed.

June 30: Whole thickness grafts 22 x 5 cm. and 20 x 4.5 cm.

¹This cap was devised by Miss E. Bowman, the nurse in charge of the patient at the Union Protestant Infirmary.

were obtained from the thighs under local anæsthesia, and were treated as usual. These were successful. All the grafts were exposed to the air after the first 48 hours, and were anointed with either Porter's ointment² to prevent drying out or with scarlet red 8 per cent. along the margins.

During the next two months a number of small superficial ulcers appeared in the cicatrix which formed before grafting was commenced, and a number of granulating areas were left by the sloughing of the isodermic grafts.

August 30: Under nitrous oxide anæsthesia whole thickness flaps from both legs, 20 x 4.5 cm., and from the abdomen, 15 x 4 cm., were removed and treated in the usual manner. It was necessary to divide the flaps in order to fit them into the irregular shaped areas. Practically all of these grafts were successful.

September 25: Several resistant ulcers appeared in the marginal cicatrix, and these were successfully grafted with small deep grafts, which were dressed with narrow overlapping strips of rubber protective.

October 8: Similar grafts were placed on three small areas where one of the thick grafts had been very slow in "topping off."

October 23: Another small ulcer in the cicatricial tissue was grafted with small deep grafts. All of these grafts were successful.

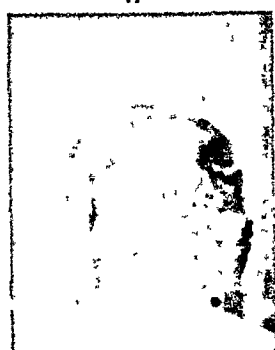
When discharged, November 16, 1909, the scalp presented the following appearance: The denuded area was entirely healed (Fig. 6). The greater part was covered with stable whole thickness skin, which was normal in appearance and was soft and movable. Acute sensation was practically confined to the cicatricial border around the grafted area. There was definite growth of fine hair on those grafts which were obtained from the thighs and legs, showing that the skin with all that belonged to it was transplanted.

The general condition of the patient was excellent, and with the aid of a wig a good cosmetic result was obtained (Fig. 7).

A comparison of these two cases is interesting. Both were females, aged respectively twenty-two and forty-one

² Porter's ointment: citrate of silver 1 part; ichthyol, 4 parts; benzoinated lard, 175 parts; lanolin, 25 parts (ANN. OF SURG., November, 1907, p. 660).

FIG. 1.

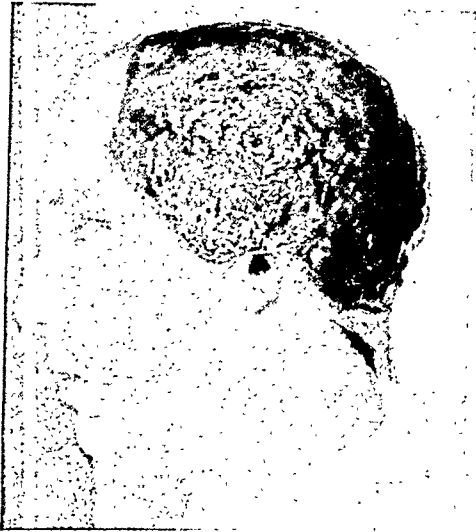


B



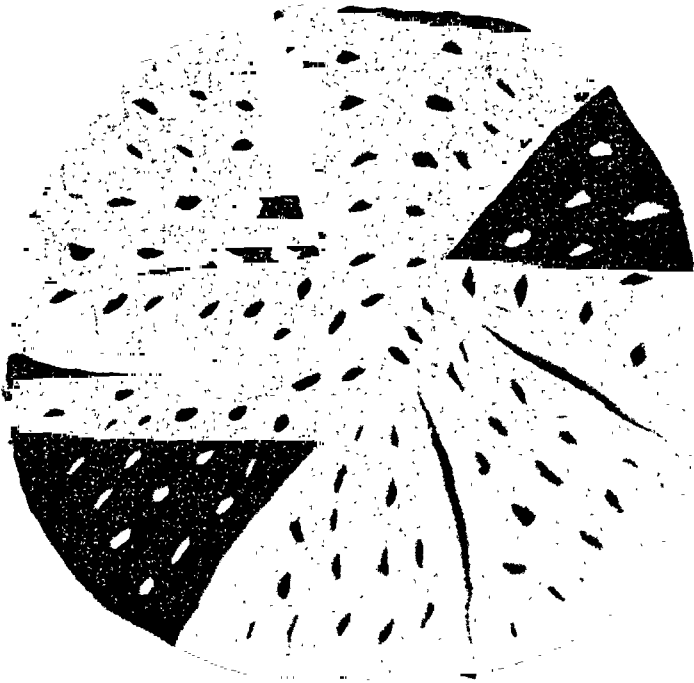
A, before grafting; B, result of grafting with Thierrch grafts (Blow).
7 x 15 cm.

FIG. 2.



The denuded area three weeks after admission to the Union Protestant Infirmary. The granulations are clean, healthy, and nearly ready for grafting. The narrow zone of cicatrization can be seen, which shows the extent of the healing from the edges since the accident occurred 22 months before, and emphasizes the slowness of healing by cicatrization. Case II.

FIG. 3.



Adjustable cap made of old linen which is button-holed to allow the escape of excretion. The diameter is 12 inches. The cap can be saturated with oily dressings, or ointments may be spread on it.

FIG. 4.



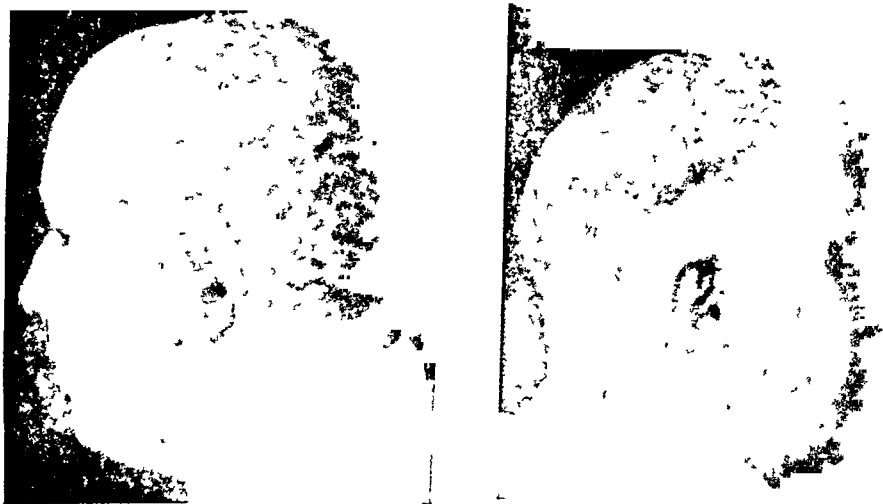
The adjustable cap shown in Fig. 3 in position. The use of this cap simplifies the dressing of the described granulating surface.

FIG 5.



A portion of the first and second graftings. The first graft, which is in front, has nearly assumed the level of the normal skin, while the one behind it is still considerably thickened. The large button-holes in the second graft can be plainly seen. Case II

FIG 6



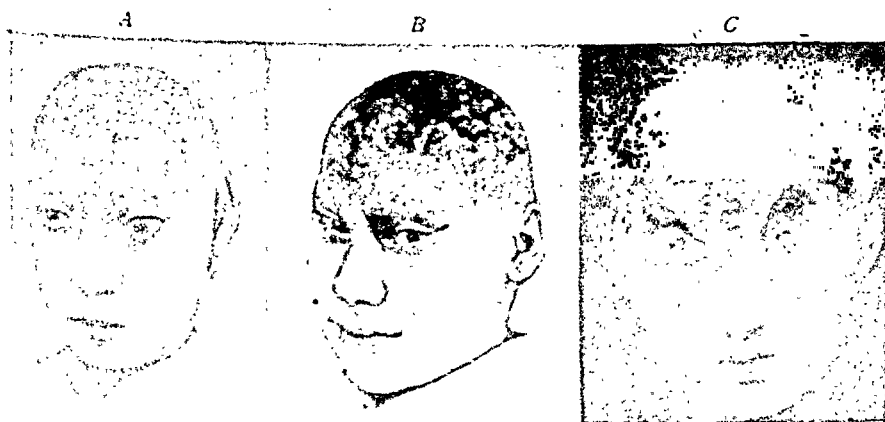
Side views, completely healed by whole thickness grafts. Case II.

FIG. 7.



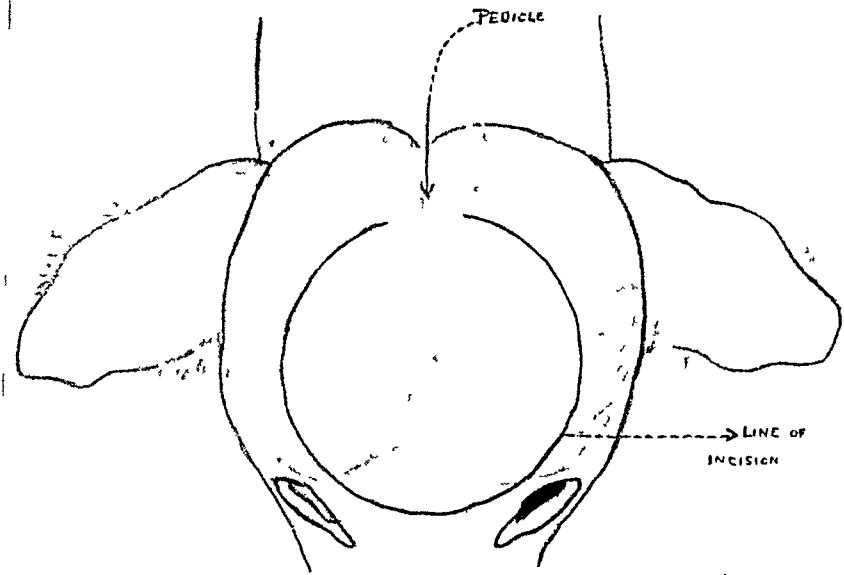
Patient with wig on. Photograph taken one month after leaving hospital. Case II.

FIG. 8.



Different grades of retraction of the eyebrows. A, Franchomme and Parisot's case, slight retraction. B, Fouchard's case, note Mongolian expression. C, Durand's case, marked retraction.

FIG 9



Outline of the incision made in pedunculated flap experiments

FIG 10



A, the rubber impregnated mesh holding whole thickness grafts in position on the posterior portion of the wound. Note the gathering in of the ends of the mesh, which are secured by adhesive strips. B, note the accurate fitting of the grafts and the snugness of the mesh.

years. Both accidents occurred in manufacturing plants and were due to rapidly revolving shafts which were unboxed.

In Case I the *line of tearing* included both eyebrows, while in Case II the tearing began at the hair line. In Case I there was slight laceration of the right ear, while in Case II the left ear was torn off and also a portion of the cheek was involved. In both cases the tear was across the neck and not in a point to the root of the neck.

There was no *loss of consciousness* in either case. There was marked *hemorrhage* in both cases, but of comparatively short duration. It was necessary to *tie the arteries* in Case II. In Case I the *immediate pain* was intense, while in Case II it was so slight that the patient was unaware that her scalp was avulsed. The *subsequent pain* was severe in each but disappeared within a short time. There were *periosteal defects* in both but without subsequent *exfoliation of the bone*. There was little or no *shock* in either. No attempt was made to *replace the scalp* in either case. In both cases the first growth of granulations on the periosteum was exceedingly slow.

Twenty-one months had elapsed after the accident before Case II came under my care, and during that time autodermic Thiersch grafts and both thin and thick zoodermic grafts had been unsuccessfully tried. There had been a slight growth of epithelium about 1 cm. in width around the wound edges.

In comparing the condition of the wounds, the types of grafts used, and the results obtained in the treatment of these cases, I will consider in Case II only the treatment carried out after May 1, 1909, at which time the patient came under my care.

The pictures presented by these two cases are very different. In Case I the difficulty was in stimulating the growth of the granulations before attempting to graft, while in Case II (21 months after the accident), the problem was how to deal with badly infected, exuberant, œdematous granulation tissue, and to bring it into a suitable condition for grafting.

In Case I only Thiersch grafts were used, while in Case II only whole thickness grafts were employed. Isodermic grafts

were tried in both, but were unsatisfactory except for a partial take in Case II. Autodermic grafts, on the other hand, were uniformly successful. The grafts in Case I were placed on scraped granulations, while in Case II all the grafts were applied to undisturbed granulating areas. The Thiersch grafts applied in Case I were cut under ether anæsthesia by the method employed at the Johns Hopkins Hospital, and wet technic was used. The greater number of whole thickness grafts on Case II were obtained under local anæsthesia, and dry technic was carried out as far as possible. Both cases were in the hospital about the same length of time.

In Case I small ulcerations appeared here and there over the grafted surface, off and on, after discharge from the hospital. In Case II small ulcerations appeared while in the hospital and one or two later, but these were on the ungrafted scar tissue, and not on the grafted surface.

I was fortunate enough to have an opportunity of examining Case I three years after her discharge from the hospital, and could in this way make a relative comparison of the healing brought about by Thiersch grafts and by whole thickness grafts.

The grafted surface in Case I was covered with a smooth, thin, shiny skin, which was freely movable over nearly the entire area. On this were several superficial ulcers. The patient said that these ulcers would heal slowly and then other areas would break down, so that ever since her discharge there had been one or more ulcers.

Sensation was present practically over the entire grafted area, and there has been constantly a feeling of weight on the vertex.

The grafted area in Case II, at time of discharge, was covered with stable whole thickness skin, which was normal in appearance and was soft and movable. The grafts which had lost their superficial layers were somewhat more pinkish, but were equally stable, and there seemed very little likelihood of ulceration.

The marginal cicatrix and areas of scar tissue were much less stable and more likely to break down.

Since discharge the patient writes that a small ulcer would occasionally appear in this scar tissue, but never in the grafted area.

Acute sensation was confined to the cicatricial border, and there were no uncomfortable sensations of weight or tightness.³

From the above, one can see at a glance that Case II was in better condition at time of discharge than Case I even after three years had elapsed, which convinces me that whole thickness grafts are the most satisfactory in the treatment of these cases.

HISTORICAL DATA.

It is generally supposed that the practice of scalping was peculiar to the American Indian, but it has been shown by Burton that this custom was not uncommon among the Asiatics, Europeans, and Africans, from the earliest times.

Friederici believes that the custom of scalping was unknown among Mongolians. He says that scalping is mentioned twice in the Bible, II Maccabees, 7, 7, and Deuteronomy, xxxii, 42, but that there is nothing at all in the original and in the Septuaginta which could be interpreted as showing the existence of the custom of scalping among the Israelites; furthermore, that Herodotus gave the only clear description of a scalping people (Seythians) of the old world, and that everything else on this subject appertains only to hints, beginnings, or remnants.

The Abbe Em. Domenech ("Seven Years' Residence in the Great Deserts of North America," chap. 39) quotes the "decalvare" of the ancient Germans, the "capillos et cutem detrahare" of the code of the Visigoths, and the Annals of Fluor (Flude) to prove that the Anglo-Saxons and the French still scalped about A.D. 879.

Friederici says, after an extensive investigation, he has been unable to confirm these annals.

³On September 26, 1910, the patient writes that her head is in splendid condition, and that she is working. Sensation is present over the entire grafted area, and is normally acute 2½ inches beyond the cicatricial border. The skin is quite soft, progress from the edge of the wound. Small superficial ulcers still occasionally occur in the scar tissue, otherwise there is no trouble whatever.

There is no doubt but that the American Indians were accustomed to scalp their enemies long before the discovery of this country by Columbus, and each tribe had its own method of scalping which was passed down from generation to generation. The amount of scalp removed, by the different tribes, varied from about the size of the tonsure of a monk to the whole scalp.

Up to thirty years ago scalping by Indians was of common occurrence on our Western frontier, although the cases were seldom reported in medical literature, but of late years this method of scalping has, happily, become exceedingly rare. Industrial scalpings, on the other hand, have increased in number, and in the last fifty years the majority of cases reported in medical literature have occurred in manufacturing centres, and when scalping is spoken of to-day industrial scalping is usually meant. The number appears to have increased chronologically with the greater development of machinery and manufacturing plants.

The number of cases is not great, and in over 26,000 house cases admitted to the Johns Hopkins Hospital, in the service of Dr. Halsted, there has not been a single case of complete scalping.

The first case of scalping due to machinery, recorded in medical literature, is that of Downs, which occurred on June 23, 1838.

Netolitzki was the first to employ grafts in the treatment of scalping, and on April 11, 1869, transplanted small elliptical shaped pieces of whole thickness skin from the back of the patient's hand. Later, on the same wound, Phillipp tried zoodermic grafts from various animals, for the first time on such a case.

Bartlett, in 1871, was the first in the United States to employ autodermic Reverdin grafts in the treatment of scalping. This also seems to be the earliest recorded case of scalping thus treated.

Socin, in 1889, was the first to employ Thiersch grafts in the treatment of scalping.

The *anatomy of the scalp* will not be considered here, on account of lack of space.

DEFINITION, ETIOLOGY, MECHANISM.

There have been many definitions of scalping, for the most part based on the amount of scalp avulsed, but a simple and satisfactory idea of the injury may be expressed as follows: By scalping we mean the forcible separation of the scalp from the cranial vault by a violent, quick force, from which results a tearing of the skin, with little or no mutilation of the surrounding teguments.

There are two clinical varieties of scalping: *incomplete*, where the whole or a portion of the scalp is separated from the vault, although it remains attached to the adjacent skin by a pedicle, which may be more or less extensive; *complete*, where the whole or a portion of the scalp is entirely separated from the cranial vault and the adjacent skin. There are several grades of each of these varieties, depending on the amount of the scalp involved.

Special conditions are necessary for the production of this accident by machinery. The patients have been almost exclusively workers in factories, and all have been females, with the exception of one case, a Chinaman, who caught his queue in revolving machinery and was totally scalped.

The scalp is caught between two forces which oppose each other, the force of the machine and the speed of rotation, against the weight of the body and the struggles of the individual. Violent and quick traction is necessary. By the strong pull on the hair, at first there is separation between the galea and the periosteum. The scalp does not give way until its elasticity has reached its limit, when the muscle parts and the skin tears. The line of separation is, as a rule, at the junction of the scalp with the skin of the face and neck, or in other words where it is thinnest, and in many instances it finishes low on the neck, in Spencer's case reaching the fourth dorsal vertebra.

The amount avulsed varies with the amount of hair caught and with the direction and intensity of the force. In incom-

plete scalping a pedicle is left at the point where the force was least, and therefore not where the tearing begins. If the pedicle is behind, the tearing begins in front, and vice versa.

A series of experiments, by Fouchard, were made on cadavers as follows: In the first series violent sudden traction was made on the scalp in a direction following the median axis of the body, by means of the plaited hair. Three attempts resulted in the tearing out of nearly all of the hair in each instance, without injury to the skin. The fourth, where the traction was not so strong and less sudden, produced no result.

In the second series the traction was operated in the same way, but the pull was made obliquely from back to front. Three attempts were made with a negative result in each, except for a limited tearing of the hair alone at the periphery of the zone of implantation.

In the third series, five experiments with traction from front to back produced five scalpings, two complete and three incomplete. The tearing in each case began at the superciliary ridges. Fouchard concludes that the tearing of the scalp is produced by a sudden and violent traction, which is exerted obliquely from front to back. The superciliary ridges act as the cutting instrument, and the skin is cut by them where it is thinnest, and the tearing follows toward the neck. He says this is the usual method in actual practice.

When the tearing begins at a different level, such as the hair line, the above described action does not occur, and the cause is obscure.

The only case in which the hair alone was pulled out without injury to the scalp was that of Vauthier, and it might be explained along the line of Fouchard's first series of experiments.

A comparison of the number of complete and incomplete scalpings by machinery is interesting, there being 80 complete and 10 incomplete.

The separation usually takes place in the loose subaponeurotic layer, but occasionally the periosteum is removed to a greater or less extent, and also the fleshy portions of the occipitofrontalis and temporal muscles.

The anatomic elements are easy to differentiate. The skin edges are remarkably clean and regular, and there is usually little or no mutilation of the surrounding tissues.

By the strict enforcement of certain rules, a large number of the recorded cases of scalping could have been avoided. The shafts and belts should be housed in as far as possible, or placed out of reach.

The female operators should be compelled to arrange their hair tightly, and always to keep it covered with a simple cap of some smooth material while in the working room.

ANALYSIS OF CASES.

Scalping due to burns, 8 cases. *Hair torn out without laceration of the scalp*, 1 case.

Complete Scalping, 91 cases.—*Scalping by Indians*, 7 cases. *Scalping by machinery*, 80 cases.

For convenience I have divided the cases of complete scalping, caused by machinery, into three general classes: first, those in which the line of tearing included one or both of the eyebrows; second, those in which the line of tearing passed above the eyebrows; third, those in which the line of tearing was not given.

Scalping by other forces, 4 cases.

Incomplete Scalping, 30 cases.—*Scalping by the claws of animals*, 2 cases. *Scalping in which the method of injury was not given*, 4 cases. *Scalping by machinery*, 10 cases. *Scalping by other forces*, 14 cases.

SUMMARIES.

Scalping due to burns, 8 cases. *Males*, 6; *females*, 2. The youngest was 7 months, and the oldest 50 years. *Age in decades*: Up to 9 years, 2 cases; 10 to 19 years, 1; 20 to 29 years, 2; 30 to 39 years, 1; 50 to 59 years, 1; no age stated, 1. *Date of cases in decades*: 1850 to 1859, 1 case; 1860 to 1869, 1; 1870 to 1879, 2; 1900 to 1909, 4. *Loss of consciousness and shock* were not stated. *Immediate pain*, very slight if any. *Periosteal defects at time of accident*, 8 cases. *Exfoliation of the bone*, 6 cases; both tables came away in 3; in 1 of which there was exfoliation of an area $5\frac{1}{2} \times 4\frac{1}{2}$ inches, and in another an area 17×11 cm. *Complications*: Cicatricial bands to sternum, 1 case; ectropion, 2;

erysipelas, several attacks, 1; sepsis, 1; abscess of brain, 1; convulsions due to pressure of scar on brain, 1; lowering of forehead due to continual pressure of scar tissue, 1. *Treatment and result:* Cases grafted, 2, both healed. *Type of grafts used*, not stated, 1; human skin and mucous membrane, rabbit, guinea pigs, dogs, and frogs, 1. *Healed by grafting* 2 cases; *healed by cicatrization*, 1; *unhealed*, 1; *result not stated*, 2; *died* 2. *Time of healing by grafting*, 4 years, 1; 1 year, 1; one case died from sepsis and the other from abscess of the brain. *Burned by coals*, 4 cases; *electricity*, 2; *carbolic acid*, 1; *boiling grease*, 1.

The absence of pain, shock, and general symptoms in the cases burnt by fire is quite remarkable. The reaction is more marked in the electric burns and carbolic acid burns.

Hair torn out without laceration of the scalp, 1 case. This case is unique, and is the only one on record caused by machinery in which the hair alone was torn out, leaving the scalp intact.

COMPLETE SCALPING, 91 CASES.

Scalping by Indians, 7 cases. These cases are interesting, and the treatment of boring with an awl the necrosed bone advocated by Robertson so many years ago is undoubtedly beneficial. To-day, however, in areas of any size, a small trephine or a Hudson burr will be found more advantageous than an awl.

Total Summary, Complete Scalping by Machinery.

Complete scalping by machinery, 80 cases. *Scalping in which the line of tearing included one or both of the eyebrows*, 53 cases. *Scalping in which the line of tearing passed above the eyebrows*, 19 cases. *Scalping in which the line of tearing was not given*, 8 cases. *Male*, 1; *females*, 79. The youngest was 9 years, and the oldest 57 years. *Age in decades*: 1 to 9 years, 2 cases; 10 to 19 years, 32; 20 to 29 years, 22; 30 to 39 years, 3; 40 to 49 years, 2; 50 to 59 years, 1. *Age not stated*, 18 cases. *Date of cases by decades*: 1830 to 1839, 1 case; 1840 to 1849, 1; 1850 to 1859, 1; 1860 to 1869, 7; 1870 to 1879, 16; 1880 to 1889, 7; 1890 to 1899, 21; 1900 to 1909, 26. Twenty-one of these cases have occurred in the United States. There was *loss of consciousness* in 6 cases. *Shock*, 14 cases; in 9 of these it was severe. *Immediate hemorrhage*, 16 cases, in 11 of which it was severe. *Subsequent hem-*

orrhage, 2 cases. *Arteries were tied* in 10 cases. *Immediate pain*, 12 cases, in 3 of these it was severe. *Subsequent pain* occurred in 5 cases, all being severe. There were *periosteal defects at time of accident* in 29 cases; in 4 the entire periosteum was torn off, and there was *exfoliation of the bone* in 2. In 21 the size of the defect was not stated; in 12 of these there was *subsequent exfoliation of the bone*. In 4 cases *very large pieces of the periosteum* were torn off, with *exfoliation of the bone* in 2. There were *periosteal defects following suppuration* in 5 cases, with *exfoliation of the bone* in 4. The *entire scalp was replaced in one piece* in 21 cases, in all but one of these there was total failure. In this case there was nearly complete healing after 98 days. *Left ear involved*, 12 cases; *right ear involved*, 11 cases; *both ears involved*, 2 cases; *ear involved, but which side not stated*, 1 case. *Retraction of the upper eyelids*, 9 cases. *Infection of the eye resulting in destruction*, 2. In practically every area grafted *small ulcerations have appeared* on the grafted area after the original healing. These ulcerations have been more or less resistant to treatment. *Cases grafted*, 57, with complete healing in 33 cases; *strips of the denuded scalp, in combination with other grafts, being used* in 2 of these cases. *Death occurred* in 8 cases, as follows: in 1839, 1 case; 1841, 1; 1863, 1; 1869, 1; 1873, 1; 1876, 1; 1878, 1; 1908, 1.

Complete scalping by other forces, 4 cases. *Males*, 1; *females*, 3. The youngest was 4 years and the oldest 60 years. *Age in decades*: 1 to 9 years, 2 cases; 30 to 39 years, 1; 60 to 69 years, 1. *Date of cases by decades*: 1840 to 1849, 1; 1900 to 1909, 3. *Loss of consciousness, shock, and hemorrhage and pain* were not stated in any of these cases. *Periosteal defects at time of accident*, 3 cases, in 1 of which there was *exfoliation of the bone*. *Exfoliation of the bone*, 1 case, the whole of the external table was exfoliated. *Complications: tetanus*, 1 case. *Treatment and results: cases grafted*, 1 case. *Type of graft used*, sliding plastic flap 8 days after the accident, with recovery in 1 month. *Healing by cicatrization*, 3 cases. *Time of healing by cicatrization*: 5 months, 1; 6 months, 1; *time of healing not stated*, 1 case.

Haubold's case is the only one on record which was completely covered by plastic flaps from the surrounding hairy scalp, and this of course was due to the retraction of the wound and to the fact that only a portion of the scalp was removed.

INCOMPLETE SCALPING, 30 CASES.

Scalping by the claws of animals, 2 cases, both males. Age, 7 years in one case, the other an adult; both were scalped by the claws of bears. In the first case the patient was healed by cicatrization in 3 months, and hair grew here and there over the wound. In the other the flap was replaced but sloughed later. There were other wounds on the back, hip, and arm. The patient died 11 days after the accident.

Incomplete scalping in which the method of injury was not given, 4 cases. Females, 3; age not stated in 1. The youngest was 10 years and the oldest 58 years. No details were given in regard to loss of consciousness, pain, hemorrhage, shock, or periosteal defects. The flap was replaced and sutured in each case. There was sloughing of part of the flap and exfoliation of the bone in 1 case, with healing in 9 months. One case healed in 2 months; 1 in 1½ months; 1, failure of the flap and no result was given. Complications: erysipelas, 1 case; suppuration, 1 case.

Incomplete scalping by machinery, 10 cases. All females. The youngest was 10 years, the oldest 40 years. Age in decades: 10 to 19 years, 5 cases, 20 to 29 years, 1; 30 to 39 years, 1; 40 to 49 years, 1. Age not stated, 2. Date of cases by decades: 1860 to 1869, 1 case; 1870 to 1879, 1; 1880 to 1889, 1; 1890 to 1899, 4; 1900 to 1909, 3. There was loss of consciousness in 2 cases. Shock, slight, 1. Hemorrhage, 5, severe in 3, slight in 2. Arteries tied in 1 case. Pain, 2, slight in both. Periosteal defects, 4. No exfoliation of the bone. Complications: left ear involved, 3; right ear involved, 1. Left shoulder badly injured, 1. Badly lacerated wrist and contusions on thigh, 1. Infection, 1. Meningitis, 1. Treatment and results: The flap was replaced in each case, and healed in 6, sloughed entirely in 2; one of these cases was healed later by skin grafting. Sloughed more than half in 1, which was healed later by skin grafting. One case died within 24 hours. Time of healing by grafting: 2½ years, 1 case. Time not stated, 1. Types of grafts used: Thiersch, 1 case; autodermic Reverdin, 1. Time of healing by replaced flaps: 10 days, 1 case; 18 days, 1; 54 days, 1; 2 months, 1; time not stated, 2. Death occurred in 2 cases, 1 on the thirteenth day from meningitis; 1 case did not regain consciousness after the accident and died on the following day.

Incomplete scalping due to other forces, 14 cases. *Males*, 11; *females*, 3. The youngest was 8 years, the oldest 76 years. *Age in decades*: 1 to 9 years, 1; 10 to 19 years, 4; 20 to 29 years, 2; 30 to 39 years, 2; 70 to 79 years, 1. *Age not stated*, 4 cases. *Date of cases by decades*: 1830 to 1839, 4; 1860 to 1869, 2; 1870 to 1879, 1; 1880 to 1889, 3; 1890 to 1899, 3; 1900 to 1909, 1. There was *loss of consciousness* in 6 cases. *Shock*, severe, 1. *Hemorrhage*, 5 cases, 3 of which were severe, and 2 slight. *Immediate pain*, 3 cases; *subsequent pain*, 2. *Periosteal defects at time of accident*, 6 cases, with no *exfoliation of the bone*. *Complications*: infection, 3 cases; epileptiform attacks, 1; meningitis, 1; Colles's fracture, 1; baldness of the flap following the accident, 1. *Treatment and results*: the flap was replaced in 13 cases; patient refused treatment, 1 case. *Healed*, 10 cases; *result unknown*, 2 cases; *death*, 1 case. *Time of healing*: 4 days, 1 case; less than 6 days, 1; a few days, 1; 9 days, 1; 11 days, 1; 1 month, 1; 5 weeks, 1; time not stated, 4; *death occurred* on the twenty-fourth day from meningitis in 1 case; *result unknown*, 2 cases.

There are probably a great number of cases of incomplete scalping reported in the literature, but listed under lacerated wounds of the scalp, which are not included in our series.

SYMPTOMS.

There are a number of immediate symptoms which differ somewhat in intensity in incomplete and complete scalping, depending upon the extent of the injury, the method of causation, and the force by which it is inflicted.

Pain is rarely complained of at the time of the accident, and may be so slight that the loss of the scalp is not realized by the patient until the hand is placed on the head. It may become very severe within a few hours. This is especially marked during the dressings and may be of sufficient severity to require either a cocaine spray or a general anæsthetic, and lasts for an hour or two afterwards. The pain may continue several weeks, but as a rule then ceases entirely. Fortunately the subsequent pain is very slight in most of the cases, and the dressings cause little discomfort.

The hemorrhage may be severe enough to give rise to a marked temporary anæmia, but is usually very slight when we take into consideration the extent of the wound and the vascularity of the scalp. It is usually venous hemorrhage, as the external coat of the veins is very closely connected with the firm tissue of the subcutaneous layer, and thus the lumen is held open. The arteries, on the other hand, although somewhat adherent to the subcutaneous tissue, behave differently on account of the inequality of elasticity of the various coats. As the traction goes on, although it may be very rapid, the middle and internal coats give way first and retract, thus diminishing the calibre and partly blocking the lumen.

There is seldom serious collapse from hemorrhage, although death from hemorrhage is the only way simple avulsion can be immediately fatal. The anæmia due to the hemorrhage may persist and materially retard the treatment.

Sometimes in spite of the fact that there is little or no pain and no hemorrhage, there quickly follow varying degrees of shock and even complete collapse. On the other hand the patient may be so slightly affected that in some cases she has insisted on replacing the scalp and walking to her home, or to the hospital.

There is usually very profuse discharge from the granulating surface, which is often depleting to the general health of the patient. In the majority of cases the result of simple avulsion on the general condition is slight, but the danger comes from the complications which may follow.

COMPLICATIONS.

These may be divided into three groups. First, those which occur at the time of the accident; second, those which occur during the progress of the treatment; third, those which are due to cicatricial contraction.

Those in the first group are due to other forces than the simple traction which causes only the avulsion. The patient may be lifted and then dropped or thrown violently against some neighboring object. Some other portion of the body

may come in contact with the moving machinery, and thus various injuries result, such as fracture of the skull, fracture of the clavicle or rib, avulsion of the thumb, etc. This group of complications is not as usual as might be supposed, as in the majority of cases the scalping is the only injury.

Those in the second group are principally due to infection. These are fortunately much less frequent than they were before the days of aseptic and antiseptic surgery, although they still occasionally occur in spite of every precaution.

It was then the rule rather than the exception to have severe inflammation with fever and suppuration, lasting for months and followed by great weakness, loss of health, and degeneration of organs due to prolonged suppuration.

Erysipelas appeared sometimes more than once during the course of the treatment. Phlegmon and abscess, septicaemia and pyaemia were common. In some instances the infection extended into the interior of the skull through the emissary vessels, or through a defect following necrosis of the bone, causing meningitis, brain abscess, and other cerebral infections, which sooner or later resulted in death.

There may be necrosis of bone with exfoliation in those cases where the periosteum is torn, especially when the bone has become dry and the granulations have not covered it. The periosteum may be destroyed later by suppuration, and bone necrosis follow.

Occasionally there is secondary hemorrhage due to the ulceration of vessel walls following infection. Hemorrhage may take place from granulation capillaries when the head is lower than the body, and also when the blood-pressure is increased during the administration of an anæsthetic, or from nausea following anæsthesia.

Tetanus has developed in several cases, and mastoiditis also is an occasional complication. There have been symptoms of iodoform and carbolic poisoning following the too free or long-continued use of these drugs as dressings. An occasional septic pneumonia has also occurred.

Those in the third group are for the most part due to

cicatricial contraction and are often very severe. They cause hideous deformities due to ectropion of the upper eyelids and occasionally an eye is subsequently lost from infection. The upper eyelid is most often pulled up and out, the result being that the axis of the palpebral cleft is deviated, becoming oblique from top to bottom and from outside to inside, giving a Mongolian expression (Fig. 8). The contraction, on the other hand, may tend to draw up the surrounding soft parts, and thus make a smaller area to be covered. Occasionally the ears are somewhat displaced by the contraction. The worst contractions follow those cases where the scalp is torn off beginning from or including the eyebrows, and the principal effort of the surgeon should be to overcome this tendency by the application of suitable grafts over this area before the contraction begins to be serious. Aside from those already mentioned there are remarkably few bad consequences after the healing is complete.

There is occasionally quite marked sensitiveness to heat and cold, neuralgia, feeling of weight, headache, and vertigo.

PROGNOSIS.

Before the introduction of surgical cleanliness, Follin and Duplay made the statement that complete scalping was always terminated by death. To-day, since the antiseptic and aseptic era began, the prognosis as to life has been excellent. The utilization of skin grafting in the treatment of such wounds has also greatly influenced the results. There is little immediate danger from a simple scalping.

In incomplete scalping there is nearly always prompt healing when the flap is replaced and properly treated, although total sloughing of the pedunculated flap is reported in several instances.

In the complete variety one of the methods of skin transplantation is necessary to bring about the desired result within a reasonable time.

The severe infections, once so common, may now be almost eliminated by modern methods of treatment.

The unsightly deformities due to the retraction of the

cyclids can often be avoided by the early application of well-placed skin grafts.

The new scalp is never as stable as the original one, except when whole thickness grafts are successful, and often there is much trouble caused by ulceration on the unstable healing due to pressure of the wig or some slight injury or infection.

The sensation of grafted areas on the cranium extends slowly, and comes in from the periphery, as in other parts of the body, and not from the underlying tissues. Thus the greater part of the grafted area may remain anæsthetic for years. In no case reported has acute sensation been present further than 2.5 cm. from the normal skin, except in Cases I and II. This lack of sensation in several instances has been the cause of infection and ulceration; for example, one patient ran a hat pin through the grafted area without being aware of it, and infection followed. For this reason it is necessary to impress on the patient the great importance of carefully protecting the newly transplanted skin until it is capable of normal resistance.

TREATMENT.

Many ancient as well as modern authors, from Hippocrates to the present day, have written of scalp wounds, and definite rules have been formulated for their treatment. We have to deal, however, with a type of scalp wound which requires patience, much care, and special treatment.

THE TREATMENT OF INCOMPLETE SCALPING.—In cases of incomplete scalping where a pedicle remains, even though it is very small, the treatment in the majority of instances is comparatively simple, as the vitality of the flap is preserved to a considerable extent through the vessels in the pedicle, and by means of free anastomosis the blood supply is soon re-established. Success, however, is not always certain, as for instance in Gussenbauer's case there was slough of the entire scalp although the pedicle was 9 cm. wide. The richness of the pedicle supply depends largely on its size and location. All that is necessary, then, in addition to this blood supply, is absolute surgical cleanliness, with proper drainage and accu-

rate approximation of the wound edges with sutures. It is useless to go into a detailed account of the cleansing, as it only varies in its minor details with the individual surgeon. However, one or two points should be borne in mind. The denuded skull should be thoroughly protected from further contamination during the shaving and careful cleansing of the flap by means of sterile dressings wet with warm salt solution. Then after the flap is cleansed it should be wrapped in warm moist dressings and held out of the way, without twisting the pedicle, while a painstaking and thorough toilet of the wound and surrounding tissues is being made. No strong antiseptics should be used in this preparation, but a soft brush with soap and water and plentiful flushing with sterile water, boracic, or normal salt solution is all that is necessary.

A first dressing of silver foil and sterile gauze, secured by a snug bandage, will be found satisfactory, but many surgeons prefer a dressing of sterile gauze moistened with normal salt solution. As a rule the healing is complete within a few days, but in those instances where there is slough of a portion of the flap, the resulting granulating wound must be treated as seems best under the existing conditions. If the wound is of any considerable size, skin grafting may be advisable to hasten the healing.

THE TREATMENT OF COMPLETE SCALPING.—When a case of complete scalping is presented, the question at once arises as to the advisability of replacing the scalp. The scalp has been replaced in 21 cases, but that of Malherbe is the only one which has resulted even in partial success, and even this is doubtful, as LeJars, in "Urgent Surgery," vol. i, 1910, page 87, speaking of this case says: "The scalp died, but turned into a parchment-like covering which remained adherent to the cranium, and under which healing took place without complications."

When we consider the poor blood supply of the periosteum, it is easy to understand failures in replacing scalps, especially when we bear in mind the liability to infection.

The old method of allowing these wounds to heal by

cicatrizization is no longer to be considered, as it is unsafe and requires so much time, and also gives an unstable result. Therefore it is necessary to obtain material with which to cover the wound by one of the methods of skin grafting.

Surface to be Grafted.—Whether to graft immediately or to wait until granulations have formed is a matter to be considered. Several cases have been successfully grafted at once or within a few hours after the accident, but the consensus of opinion is that it is safer to wait for a better blood supply.

I believe that there is little if any time gained by immediate skin grafting in these cases, although it is advisable to transplant strips of the torn off scalp. It is much better to wait until the wound is covered with healthy granulations before attempting to graft. If a fresh case came under my care, I should try to preserve at least a portion of the scalp, and apply it in strips when the conditions seemed favorable.

The grafts may be placed on undisturbed granulations or on granulations slightly rubbed with gauze sponges, or on the firm base after the granulations have been removed.

It is undoubtedly advantageous in cases of avulsion to place the grafts on undisturbed granulations, as there is no pain in the preparation of the surface; no loss of blood, which is an important point in cases already much depleted; little likelihood of blood or serum collecting under the grafts, and no danger of stirring up infection. It seems reasonable to believe that the capillary loops of undisturbed granulations are in better condition to immediately penetrate the graft than if these loops have been disturbed or curetted off and have to regenerate before they can penetrate and effectually nourish the newly transplanted skin. This regeneration takes about 24 hours, which means that considerable time is lost before the newly formed vascular loops are even ready to enter the grafts. This time is gained, therefore, by placing the grafts on undisturbed, healthy granulations.

Nature begins her attempts at healing by the formation of granulation tissue, which first appears at the margins of the

wound and along the line of the cranial sutures. These granulations spread to join other numerous similar smaller areas, which soon spring up over the surface of the periosteum, and finally cover the entire wound. Should there be a defect in the periosteum, granulations often cover the denuded bone, but sometimes there is exfoliation of the outer table due to necrosis, in which case the granulations spring from the diploe.

It is important to suture any rent in the periosteum if possible, but if there is a loss of substance, dress the uncovered bone with wet dressings, so that it will not dry out and become necrotic. A piece of rubber protective over the denuded bone will also keep the bone moist until the granulations have formed over it.

Stimulation of Growth of Granulation Tissue.—In some instances there is much difficulty in causing the granulations to grow on the periosteum satisfactorily, and as the success of every method of grafting in these cases depends on the healthy state of the granulations, it is of prime importance that the necessary condition be brought about as soon as possible. This result depends to a large extent upon the general health of the patient, therefore a vigorous building-up treatment should be inaugurated in addition to the local treatment.

Classification of Skin-Grafts.—In a general way grafts may be divided into *thin grafts*, where only a portion of the thickness of the skin is utilized, as obtained by the methods of Reverdin and Thiersch, and *thick grafts*, where the whole thickness of the skin is used. This latter division includes whole thickness sessile flaps and whole thickness pedunculated flaps.

Grafts may be further divided into *autodermic*, where the graft is obtained from the same individual; *isodermic*, where the graft is obtained from another individual of the same species, and *zoodermic*, where the graft is obtained from a lower species.

The Use of Isodermic Grafts.—There is much difference of opinion as to the advisability of utilizing isodermic grafts, and many surgeons insist that only autodermic grafts should

be used. Of course autodermic grafts are more likely to succeed. However, a study of the results obtained by means of isodermic grafts at the Johns Hopkins Hospital, and also my own experience with these grafts, have convinced me that both thin and thick isodermic grafts are well worth trying, and that very good lasting results may be secured if the grafts are obtained and transplanted with the proper technic.

Zoodermic Grafting.—Both thin and thick grafts have been tried on a number of cases of scalping, but with no permanent success. The skin of dogs, lambs, rabbits, and guinea pigs, etc., has been utilized, and while many of the grafts at first would apparently take, in the course of a few weeks they would be absorbed. I think that zoodermic grafts have a better chance of ultimate success in other regions of the body which are less exposed than the cranium.

Whether to cover the entire wound with grafts at one time is a matter to be determined by the individual surgeon. It has been done in one or two instances, but the majority of surgeons prefer to graft only a portion at a time, say a half or a third. There is no reason why the entire area should not be covered at one time with Thiersch grafts, but some difficulty might be encountered in securing enough whole thickness skin to cover an entirely denuded cranium at one time.

Method of Preparing Skin before Cutting Grafts.—A simple and satisfactory method of cleansing the skin before cutting the grafts is to shave the part selected, then scrub carefully with green soap and water. Rinse with sterile water, sponge with ether followed by alcohol. Then rinse thoroughly with sterile normal salt solution and dry with a sterile towel.

Method of Preparing Healthy Granulations to Receive Grafts.—On the day preceding the operation, remove all secretions and crusts. Wash thoroughly with sterile boric solution and dry. Paint with tincture of iodine and dress with balsam of Peru and castor oil, 2 to 6. Allow this dressing to remain in place until the time of operation. Then

remove it and wash the wound carefully with warm boric solution, or normal salt solution sponges, without causing bleeding. Follow this by an irrigation of normal salt solution and then dry carefully with sterile gauze.

Place several layers of dry gauze over the wound, and press them down firmly on the granulations, removing them only when the grafts are ready for application.

I will not take up the *technic of grafting*, as I have fully covered this matter in vol. xv, of the Johns Hopkins Hospital Reports.

Transplantation of Hair-bearing Skin.—In those cases in which the eyebrows have been torn off, small whole-thickness flaps of hairy skin from the pubis or any other hairy region, with a portion of the subcutaneous tissue, may be successfully transplanted to the eyebrow region and the hair will grow. Fine hair also grows on whole thickness flaps taken from the thigh. Enz says that hair grows at first on the transplanted pieces of scalp, but that it soon falls out. Lotheissen had a similar experience in transplanting skin from the pubic region. Burdel, on the other hand, found in his case that hair grew on the areas transplanted and did not fall out. I have successfully transplanted hair-bearing skin on other parts of the body, and later there was a vigorous growth of hair. Several attempts have been made to transplant single hairs including the sheath, but without success. No hair whatever will grow on those areas covered with Thiersch or Reverdin grafts, and this is easy to understand, as the hair-growing portion of the skin is not transplanted.

The Treatment of Ulceration of the Grafted Surface.—The treatment of small ulcers, which appear in the cicatricial tissue and here and there over the areas grafted with thin grafts, is sometimes very tedious and unsatisfactory. Where these ulcers are of any considerable size, say 1 cm. in diameter, much time can be saved by grafting with small deep grafts as soon as the granulating base is healthy. This healing will be more stable than on those ulcers which heal spontaneously, and I have not yet seen an instance in which the ulcer has broken down again after this treatment.

Another method which has given me satisfaction is the use of 8 per cent. scarlet red salve, made up in simple vaseline or in balsam of Peru ointment. By this means the epithelium seems to be stimulated and a good stable healing brought about. However, a combination of these two methods is probably the quickest and best. Apply the small deep grafts first to the untouched granulations, and dress with overlapping strips of protective. Then from 24 to 48 hours later remove the protective and dress with scarlet red ointment. This combination is also advantageous in hastening the healing of those whole thickness grafts which cast off some of the outer layers and are slow in "topping off."

Treatment of Complications.—No hard and fast rules can be laid down for the treatment of complications, but each must be taken in hand promptly.

All the modern advances in the treatment of infections with autogenous and stock vaccines, serums, etc., must be utilized in the severe cases, in addition to the local treatment.

Ectropion and similar deformities can be prevented by early and proper grafting, but should they occur, relief can only be obtained by a plastic operation or further grafting.

ANIMAL EXPERIMENTS.

Through the courtesy of Dr. Harvey Cushing I was able to carry out the experiments outlined below, in the Hunterian Laboratory of the Johns Hopkins Medical School.

Young animals between 3 and 12 months were used for these experiments. The scalps were shaved and then washed with soap and water, followed by alcohol and ether. Dry technic was employed throughout until the flaps were replaced. Ether anæsthesia was used in each experiment.

Experimental scalping on dogs presents a number of difficulties, especially in the after treatment. The great movability of the dog's scalp and the difficulty in immobilizing the replaced flap are factors to be considered, since absolute immobility is essential, in order that the blood supply may enter the flap within a reasonable time.

The constant scratching and rubbing, with the consequent

disarranging of the dressings and even of the flap itself, and the liability to infection must also be thought of. It is indeed fortunate that all of these troubles can be eliminated, to a large extent, in the treatment of the human. It is, therefore, hard to draw accurate conclusions from the experiments, and especially from those cases where the flap was totally removed.

SERIES I.—Complete Removal of a Flap of the Scalp, with Replacement within 20 Minutes; Résumé.—Thirteen experiments. The flap removed varied between 1.25 and 6 cm. in diameter. In 11 the flap included all the tissues down to the periosteum and fascia of the temporal muscles. In 2 the fascia of the temporal muscles was removed and the flap was placed on muscle tissue. The superficial muscles were removed from the flap in 10, and were allowed to remain in 3. Four flaps were replaced immediately. Five flaps were replaced after 10 minutes. Two flaps were replaced after 15 minutes. Two flaps were replaced after 20 minutes. All were sutured into position. Four were button-holed and drained. Nine were button-holed but not drained.

Dressings.—Four were dressed with balsam of Peru, 2 parts, and castor oil, 6 parts, on gauze, and bandaged. Three were anointed with vaseline and exposed to the air without other dressing. Two were exposed to the air without dressing. One was dressed with moist salt gauze and protective. Three were dressed with amberine.⁴

Result.—Total failure of all. In 9 of these the flap dried out, and the four which were dressed with moist dressings macerated.

On removal of the flap in every instance the wound was covered with healthy granulations, even over the periosteum. The wounds healed promptly by cicatrization, leaving a smooth scar which was markedly smaller than the original wound, and in no case was there any noticeable retraction of the eyebrows.

SERIES II.—Complete Removal of a Flap of the Scalp, with Replacement 24 and 48 Hours Later; Résumé.—Six experiments. The flaps removed varied between 2 and 3.5 cm. in diameter. They included all the tissues down to the periosteum and fascia of the deep muscles. All were kept in sterile jars containing a moist salt sponge. Four were replaced after 48 hours, and 2 were replaced after 24 hours. The granulations were stimulated by fitting several layers of dry gauze into the defects and covering with overlapping strips of protective. All the flaps were sutured into position and all were button-holed.

Dressings.—Four were dressed with overlapping strips of protective and moist salt gauze, and 2 were exposed to the air without dressing.

Result.—There was total failure in all. Four flaps macerated and sloughed. Two dried out. The healing was as described in Series I.

SERIES III.—Flap Separated from the Surrounding Skin, but not

⁴ Amberine is said to be a mixture of wax, paraffine, and rosin, which can be applied very hot without burning the tissues. It acts as a moist dressing, and it is claimed that it keeps its heat for a considerable time.

Lifted from Its Bed; Résumé.—Four experiments. In this series an incision was made around an area of scalp about 6 cm. in diameter down to the periosteum and temporal fascia. This incision cut off entirely the circulation except from immediately below the flap. All the flaps were sutured and freely scarified.

Dressings.—Three were anointed with vaseline and exposed to the air, and 1 was exposed to the air without vaseline.

Result.—In all there was puffiness of the flap for a few days. A small portion of one flap sloughed, otherwise there was *per primam* healing in all. The final result in all showed an area of normal appearing scalp covered by a full growth of hair. This was surrounded by a slight scar which was freely movable with the rest of the scalp.

SERIES IV.—Pedunculated Flaps; Résumé.—Four experiments. The flaps and pedicles varied in size as follows: 5x7 cm. with a pedicle 1.25 cm. broad; 6 cm. in diameter with pedicle 1.5 cm. broad; 6 cm. in diameter with a pedicle 8 mm. broad; 5 cm. in diameter with a pedicle 6 mm. broad. The incision was carried down to the periosteum and fascia of the temporal muscles. Each flap was lifted and held away from its bed for from 10 to 20 minutes. All were replaced without removing the superficial muscles and all were sutured and button-holed. Three were drained with protective wicks through button-holes in the adjacent skin, and the fourth was not drained.

Dressings.—All were anointed with vaseline and exposed to the air.

Result.—There was thickening of all the flaps for the first few days. There was *per primam* healing in each case with no slough. The result was a freely movable flap of normal appearance and with a normal growth of hair. The flaps were all cut as in Fig. 9.

CONCLUSIONS.

Series I seem to show that it is useless to replace a totally removed area of scalp and expect it to heal in its bed, even if of small size. Also that granulations appear to grow well on the periosteum under the re-applied flap. For this reason alone, then, the scalp might be replaced *in toto* after proper cleansing and free drainage, and if carefully watched and removed at the proper time would not cause infection and might stimulate the growth of granulations on the pericranium.

In spite of the discouraging results in Series II, I believe that this is a procedure which promises well, as whole thickness grafts can be preserved so satisfactorily that a portion of an avulsed scalp could easily be preserved and applied after the granulations had formed.

Series III indicate that there is sufficient blood supply from below to preserve a flap, which is completely isolated from

the surrounding circulation, until the normal circulation is re-established.

Series IV show that comparatively large areas of scalp with small pedicles may be successfully replaced, and the final condition of the replaced flap is practically that of the normal scalp in movability, in appearance, and in its ability to grow hair.

The scarification of the flap is important, as the openings allow the escape of the blood, which easily enters the flap but cannot leave it promptly until the circulation is re-established, and thus prevents congestion. It also allows free drainage of any blood or serum from beneath the flap.

COMMENTS.

There are two clinical varieties of scalping, incomplete and complete. In this paper we have considered 30 cases of incomplete scalping, 91 cases of complete scalping, and in addition 8 cases due to burns and 1 case where the hair was torn out without injury to the scalp. Ninety-one of these accidents were caused by machinery, and all but one were females.

The scalp is caught between two forces which oppose each other. The line of separation is as a rule at the junction of the scalp with the skin of the face and neck.

The amount avulsed varies with the amount of hair caught and with the direction and intensity of the force. The direction of the force is usually obliquely, from front to back, with the superciliary ridges acting as the cutting instrument. The separation takes place in the loose subaponeurotic layer, but now and then the periosteum is removed to a greater or less extent.

The symptoms differ somewhat in intensity in incomplete and complete scalping, depending upon the extent of the injury, the method of causation, and the force by which it is inflicted.

The pain is usually slight. The hemorrhage may be severe, although it is generally of short duration. Shock may be profound, but in the majority of cases the direct result of simple avulsion on the general condition is slight. The danger comes from the complications, which may be divided into

three groups: first, those which occur at the time of the accident; second, those which occur during the progress of the treatment; third, those which are due to cicatricial contraction.

The prognosis as to life since the advent of antiseptis and asepsis has been excellent. The utilization of skin grafting in the treatment of these wounds has also greatly influenced the results.

The treatment of cases of scalping requires patience and much care, and varies markedly in the incomplete and complete varieties.

In cases of incomplete scalping, all that is necessary in the majority of cases, in addition to the pedicle supply, is absolute surgical cleanliness, with free drainage and accurate approximation of the wound edges with sutures, and properly chosen dressings.

The treatment of complete scalping is a much more difficult problem. Both clinical and experimental evidence show that it is useless to replace the scalp *in toto* and expect it to heal, but strips of the scalp may be successfully applied on the periosteum along the wound edges, as immediate whole thickness grafts. I believe that it would be well worth trying to preserve a portion of the avulsed scalp to be applied when the granulations are well started.

The scalp may be replaced, sutured, and drained after very thorough cleansing, and used as a dressing, and if carefully watched and removed at the proper time will not cause infection. I have noticed in experimental work on the scalp that granulations seem to grow more readily on the pericranium under a flap, which subsequently sloughed, than under any other dressing.

As the old method of allowing these wounds to heal by cicatrization is no longer to be thought of, one of the methods of skin grafting is necessary..

Immediate grafting has been successful in a few cases, but it is better to wait until the granulations are in good condition. The periosteal blood supply is very poor and granulations form on it slowly, and the chance of success on a large area of uncovered periosteum is small.

Grafts may be placed on scraped or on undisturbed granulations, and I have found that any type of graft will take as satisfactorily, if not more so, on a healthy undisturbed granulating area than on a fresh wound.

The health of the patient is important and the success of every method of grafting depends upon the healthy condition of the granulations.

Grafts may, in a general way, be divided into *thin grafts*, where only a portion of the thickness of the skin is used, and *thick grafts*, where the whole thickness is used. These may be either *autodermic*, *isodermic* or *zoodermic*. Autodermic grafts are of course the most likely to succeed, but my own experience has shown me that isodermic grafts are well worth trying.

One or two wounds have been covered with grafts at one time, but usually only a portion is covered at a time.

It is difficult to immobilize grafts on a rounded surface like the cranium, but this has been overcome by the use of rubber impregnated mesh, as can be seen in Fig. 10.

Grafts obtained by Reverdin's method have been used in several cases, but a great deal of time is consumed and the final healing is unstable when compared to the other methods, and there is more likelihood of contraction.

Since 1889 the majority of these wounds have been covered with grafts obtained by the method of Thiersch, and this type of graft is chosen by most surgeons, and undoubtedly gives quicker and better lasting results than can be obtained by the small epidermic grafts of Reverdin.

Whole thickness grafts have been used in conjunction with thin grafts on a few cases, but my own case is the only one, as far as I can ascertain, which has been completely healed by means of whole thickness grafts. There is no doubt but that the healing from whole thickness grafts is the most stable, as is shown in the comparison of the results in Cases I and II, and it seems to me that this method should be employed in the treatment of these wounds.

THE RESPONSIBILITY OF THE TONSIL IN TUBERCULOUS ADENITIS.

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To attempt to prove that the gland at the angle of the jaw may be infected with tuberculosis by way of the tonsil with which it is in such immediate anatomical and physiological relation would seem a demonstration of the obvious. No one is likely to dispute it, but when we ask whether the tonsil is the uniform, the occasional, or a rare source of cervical adenitis, we may expect widely different opinions.

For its frequent etiological relationship we have the following: Pathological conditions are frequent in children in both tonsils and lymph-nodes. When the tonsil is inflamed from any cause the tonsillar nodes at the angle of the jaw are the first to enlarge. One familiar with the early stages of tuberculous adenitis in children will agree that in at least 90 per cent. of cases the first nodes to enlarge are these same tonsillar nodes. Lymphatic anastomosis being very free, this does not rule out the possibility of infection of these nodes from a back tooth, the pharynx or the nasopharyngeal adenoids. Later in life infection of both tonsil and lymph-nodes is less common. Wood, of Philadelphia, says on the basis of personal observations, that the tonsils of consumptives show evidence of tuberculosis in the vast majority of cases, though the rest of mouth, nose, and pharynx does not. Dr. A. M. Shrady, with a very long experience at the Seton Hospital for Tuberculosis says it is a rare occurrence for consumptives to develop clinical tuberculosis of the tonsil and that they usually die without clinical signs of infection of neck nodes. On the other hand the infrequency of clinical tonsillar tuberculosis and hitherto the almost uniform failure to demonstrate it microscopically have made some question the etiological importance

of the tonsil in cervical tuberculosis. Other avenues of infection are by no means wanting, such as gums, nose, and pharynx, and even the skin of the face, lips, and scalp. In the past ten years we have seen probably 25 cases of tuberculous femoral adenitis result from scratches on the foot. One child under six months of age had a tuberculous inguinal bubo following a scratch with a diaper pin at the base of the penis. These cases are mentioned simply to show that almost any part of the body's surface may admit the bacillus. The writer submits the results of the examination of sixty-five whole tonsils recently removed. These can be considered in three groups:

1. *Fifty-seven tonsils removed for a variety of reasons from children and embracing all types of tonsils.* In none of these patients was there reason to suspect tuberculosis in the neck or other part of the body. None showed tuberculosis on microscopic examination in the tonsil, *i.e.*, there was no accidental discovery of tubercle in a tonsil where it was not suspected. This confirms the experience of others. Hodenpyl examined several hundred tonsils without finding any tuberculous. Hurd quotes Wright as having examined 60 unselected specimens without finding tubercle. Judd, of Rochester, says that at the Mayo's Clinic only one or two tuberculous tonsils have been found among some hundreds of tonsils sectioned. In conversation one frequently hears it said as a piece of common knowledge that tonsils removed for all causes are found tuberculous in 5 to 10 per cent. of cases. I am unable to find who said it first and feel certain that it does not approximate the truth. With the uniform result of examinations by Hodenpyl, Wright, the Rochester Clinic and myself we feel safe in asserting that one is not likely to find the tonsil harboring the tubercle bacillus without other manifestations of tuberculosis in the body.

2. *Five tonsils showing well-defined tuberculous lesions and all taken from children with recent tuberculous cervical adenitis.*

CASE I.—A small collection of nodes at angle of left side of jaw, largest hickory-nut sized. Left tonsil small. In it, several

discrete scattered tubercles, few giant cells, just a suspicion of central necrosis. A couple of tubercles located in the capsule of the tonsil.

CASE II.—Boy at Sea Breeze Hospital for Tuberculosis. Adenitis has not been operated on. Has widely distributed enlarged nodes in both sides of neck. Tonsils are peppered with discrete miliary tubercles both near mouth surface and capsule. No giant cells or necrosis.

CASE III.—Age three years. A collar of enlarged nodes in both sides of neck. Seem recent. Von Pirquet positive. Tonsil quite small. Small area in one tonsil shows giant cells with peripheral nuclei and poorly defined epithelioid tubercles. After removal of tonsils the glandular enlargement partly subsided and child removed from hospital without operation upon the neck.

CASE IV.—Already reported in ANNALS OF SURGERY, April, 1910, p. 577. The enlargement of neck nodes followed a tonsillotomy. Discrete typical miliary tubercles found in tonsillar stumps.

CASE V.—Child, age eight years. A few soft glands at angle of jaw found to be tuberculous. The tonsil on the same side as the nodes showed many typical miliary tubercles. The enlargement of nodes was recent.

3. Cases with tuberculous glands in neck but without tuberculosis in tonsil.

CASE VI.—Child, age three. Glands in right side of neck of one month duration. Von Pirquet positive. The largest node is the tonsillar one, but the first one to enlarge was in front of the submaxillary salivary gland and it was the only gland at operation which had gone to the stage of suppuration. Tonsils, small, appear normal and no tuberculous lesions found in them. In this case it would seem likely from location of swelling that infection took place through lip, gum, or floor of the mouth.

CASE VII.—Child. Tonsillar nodes enlarged. Also a large soft node in the substance of the parotid gland just in front of external auditory canal. Von Pirquet positive. Nodes proved tuberculous. Tonsil without tuberculosis. The clinical evidence would suggest that this was a case of scalp infection as the most advanced tuberculous lesion was in a node well up in the parotid gland.

CASE VIII.—Two good-sized tonsils not found to be tuberculous. Von Pirquet positive. A collection of nodes in right tonsillar group of several months' standing proved to be tuberculous. In this case clinical evidence suggested tonsillar origin.

As illustrating the probability with which we can infer the point of infection from the location of the first involved node, we may mention the following case: A child, aged four, had tuberculous nodes on the right side in the tonsillar and submaxillary region. A submaxillary node was suppurating. There was a red spot on the upper gum, at the insertion of the second incisor tooth, about one-fourth inch in diameter. This little piece of gum was removed at the same time as the nodes and showed typical tuberculous lesions. This is the only case in which we have demonstrated a tuberculous gingivitis as the starting point for tuberculous adenitis. In this case the tonsils appeared normal and were not removed.

There is an impression that the tubercle bacillus may penetrate the tonsil without producing any manifestations of its presence and be carried through it to the neck nodes. So far as I know, the only basis for the belief is one experiment by Wood of Philadelphia on a pig. He rubbed tubercle bacilli on the tonsil, killed the pig later and identified bacilli in the cervical glands only—not in the tonsil.

To sum up, 57 tonsils of patients not clinically tuberculous show no tuberculous lesions. Of 8 patients with cervical adenitis the tonsils are tuberculous in five. In two there is evidence of other than tonsillar origin for the infection. In one the adenitis was of long standing and may have been extra-tonsillar in origin or slight tonsillar lesions may have escaped observation.

These results closely parallel those of Hurd. In an examination of 11 tonsils from patients with tuberculous nodes he found tuberculosis in the tonsil 8 times. In an examination of 13 tonsils of persons with slightly enlarged neck nodes, not believed from clinical evidence to be tuberculous, only one tonsil showed tubercle. In cases then where there is clinical evidence that the tonsil is responsible for a tuberculous adenitis,

both Hurd and myself have as a rule found tuberculous lesions in the tonsil.

CHARACTER OF TONSILLAR TUBERCULOSIS.

Hurd has said that tuberculosis is to be found in the small buried tonsils, not the large soft elevated ones. We may put it in another way and say tuberculosis does not greatly enlarge the tonsil. In none of our five have the tonsils been considerably enlarged. The lesions as seen by the microscope have shown considerable variation in type. For instance, giant cells are in some few, in others abundant. In general we may say that the lesions are scattered rather than confluent, ulceration was never present and there was never more than a suggestion of central necrosis. In other words, we see the early or cellular type of lesion rather than the late fibrous and necrotic. The tubercles have been found both superficial and deep—in one case even in the capsule.

With a recognition of the frequency of tonsillar infection we shall probably more frequently remove the tonsil in cases of cervical adenitis than has been done in the past with the idea of avoiding reinfection of neck nodes. That we have been able to cure so large a per cent. of gland cases without removing the tonsil is simply another illustration, if one be needed, that we do not cure surgical tuberculosis by removing every single bacillus and lesion but by reducing the load of infection with which the body must contend.

If the tonsils and nodes are both to be removed, it would not seem wise to attempt both at one sitting. Which shall be done first will probably have to be decided on the merits of each case. We have seen the nodes largely subside on removal of the tonsils alone; in other cases the extensive involvement of such nodes makes their removal much more important than that of the tonsil.

The material for this paper has mainly come from St. Mary's Hospital for Children. The pathological work has been done at the Laboratory of Surgical Pathology of Columbia University through the kindness of Dr. W. C. Clarke.

TREATMENT OF TUBERCULOUS GLANDS OF THE NECK.*

A STUDY OF 649 OPERATED CASES.

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TREATMENT of tuberculous glands of the neck by excision dates from the time of Galen, although the first systematic dissections were probably done by Billroth in 1870 and by Rushton Parker and others in 1871.

Formerly, glandular tuberculosis of the neck was supposed to be an expression of general glandular infection, and it was believed that the infection travelled upward from a focus at some point inside the chest. Until the appearance of the comparatively recent study of the anatomy of the lymphatic system by Sappy, Leaf, Poirier, and Cuneo, our knowledge of the source of infection and the avenues travelled by it was very meagre.

There are approximately 800 glands in the entire human body, and nearly 300 of these lie within the tissues of the neck. The glands in this region are the first to appear in the embryo. Placed at the juncture of the head and neck are several groups of glands forming a kind of "glandular collar." This collar is composed of:

1. Suboccipital group, whose afferent vessels drain the occipital portion of the scalp; and efferent vessels which pass to the substernomastoid glands.

2. Mastoid group, which is composed of two or three glands receiving drainage from the temporal region of the scalp and ear, and with efferent vessels to the substernomastoid glands.

* Read before the Section on Surgery, New York Academy of Medicine, May 19, 1910.

3. Parotid glands. These glands are again divided into several groups lying in different relations to the parotid salivary gland. There are from ten to twenty glands in this group; some lying superficially, some within the parotid, and a separate group lying between the parotid and pharynx. The afferent vessels to these glands come from the anterior part of the scalp, ear, eyelids, root of the nose, nasal fossa, and pharynx, and the efferent vessels pass into the deep cervical chain.

4. The submaxillary glands, three to six in number, lie along the lower border of the submaxillary bone. This group drains the upper and lower lip, cheek, nose, side of the tongue, and gums, and empties into the deep cervical chain.

5. Submental glands; a small group lying between the anterior bellies of the digastric muscles receiving afferents from the lower lip, floor of the mouth, and tip of the tongue, and sending efferents to the submaxillary glands.

6. Retropharyngeal glands. These glands receive vessels from the nasopharynx and drain to the deep cervical chain.

It will be seen that this glandular collar, composed of the six groups of glands, drains the entire scalp, skin, and mucous membrane of the head and face, and that each group sends its drainage to the deep cervical chain. There are no lymphatic vessels passing upward or communicating at any point within the skull.

The descending cervical chain, composed of the glands lying anterior and posterior to the internal jugular vein, and also of those lying in the supraclavicular region together with the secondary groups, may best be considered in a pathologic or surgical sense as one large group. The deep groups are each made up of a number of large glands. In the upper half of the neck they lie almost entirely behind the sternomastoid muscle, while in the lower division they lie opposite the posterior border and in the supraclavicular triangle. The chain extends from the tip of the mastoid process to the juncture of the internal jugular and subclavian veins. The afferent vessels to this chain are those coming from the groups making up the

cervical collar, and also several vessels passing directly to the deep glands from the scalp, tongue, palate, œsophagus, and thyroid. The vessels leading from these groups (deep chain-subclavicular-supraclavicular) unite on either side of the neck into one or two large lymphatic vessels called the *jugular trunks*; and these in turn empty on the right side into the internal jugular or subclavian veins, and on the left side directly into the thoracic chyle duct.

The glandular system in the neck terminates on either side in these large lymphatic vessels and has no direct communication with the lymphatic system in the thorax. Poirier and Cuneo, speaking of the afferent vessels of the supraclavicular group, say: "On the other hand these glands receive no vessels coming from the mediastinal glands. Cases of adenitis following mediastinal or abdominal neoplasms can only be explained by a retrograde thrombosis of the afferent vessels of these supraclavicular glands."

To me it seems very important that we should appreciate this point. A great deal of the incomplete and half-hearted work done in removing these glands has been due to the conviction that the diseased condition extended down into the mediastinal glands. From a more thorough study of the anatomy of this region, we now know that direct extension from the cervical glands into the mediastinal glands is impossible, and, therefore, that inflammations and neoplasms affecting the cervical lymphatics are *local* until they pass into the general circulation.

It is a fact generally accepted that the best treatment of accessible, tuberculous lesions, when they are still local, is that of excision. We know that in cases of tuberculosis of one kidney a very high percentage can be cured by removal. A similar process in almost any of the abdominal viscera, if diagnosed before too extensive, can be excised, and in the large majority of instances no further trouble will occur. The same is true of tuberculosis of the joints, epididymis, etc.

We are seldom able to positively demonstrate the exact avenue of the infection. Occasionally we may find the bacilli

in a decayed tooth, tonsil, or lupus area, but more often the point of invasion cannot be found. It has been shown, experimentally, that cultures of tubercle bacilli swabbed over the surface of the tonsil may leave no trace of their passing through that organ, but will invade the glands draining the tonsil. In our cases we were seldom able to trace back to the source of entrance. Examination of several hundred tonsils showed tubercles in much less than 1 per cent. In 1000 cases, 2.3 per cent. had positive tuberculous lesions.

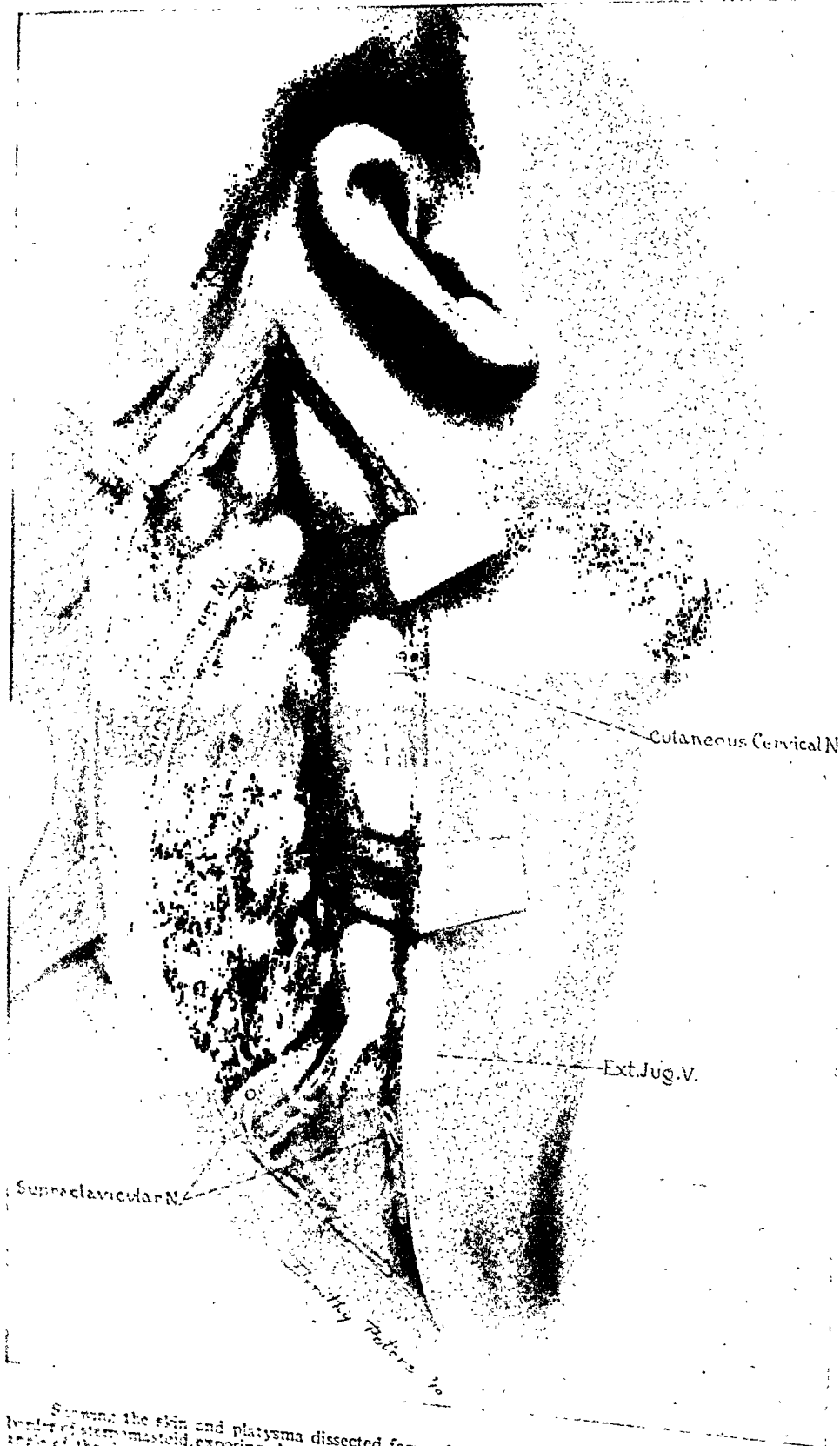
From the histories of our cases of tuberculous glands, we find that in 80 per cent. the first enlargement was beneath the upper end of the sternomastoid muscle; in 18 per cent. the first noticeable enlargement was in the submaxillary, submental, or parotid regions. In four cases the first cervical gland to enlarge was in the supraclavicular group. In each of these four cases the axillary glands were also involved; the infection having presumably entered through an abrasion of the finger or hand. Several cases followed closely upon suppurating otitis media.

Indications for Operation.—If we were to make a routine examination of a great number of children between the ages of four and ten, we would find in the majority of them varying degrees of enlargement of the glands. The pathologic changes in these glands, formerly called *scrofulous*, are in part simple hyperplasia, in part tuberculosis. There is no differential diagnostic criterion of the initial stage of glandular tuberculosis. The tissues in these glands predispose and invite tuberculous infection. In this particular type of case our method of treatment has been as follows: First clear the throat of adenoid tissues and tonsils and give such attention as is necessary to the teeth and nose. Assisted by tonics, especially syrup of the iodide of iron, and with out-door living, this treatment has been sufficient to cure most of these cases. The cases that have been perfectly cured seem to be of the hyperplastic type, or, at least, to have been only to a slight degree invaded by the tubercle bacillus. We have occasionally seen a child with cascating nodes. Such cases require, in addition to the above treatment, removal of the infected nodes and drainage. If the

glands still continue to enlarge and other glands become involved, it will be necessary to do a complete excision to effect a cure. Most of the patients upon whom we have done a complete excision of the glands have been over fifteen years of age; 18 in 649 cases were under ten years. In the presence of a discharging sinus, it does not appear advisable to excise the glands; we have usually curetted and treated by swabbing with equal parts of tincture of iodine and carbolic acid. As soon as the sinus heals, a radical operation can safely be done if necessary.

Pulmonary invasion is not necessarily a contraindication to operation upon tuberculous glands of the neck. In ten instances we have operated upon patients who showed tubercle bacilli in the sputum. Nine of them were greatly improved and several of them were apparently cured by the operation. One developed an acute diffuse tuberculosis after the operation.

The chief objection to radical excision of glands of the neck is the resulting scar. Various incisions have been described and used. At one time the removal of the glands through many separate incisions was recommended. We have found that if we follow the natural creases in the neck and keep the incision as nearly as possible transverse, as suggested by Dowd, we can remove the gland-bearing fascia in one piece with very little scar or deformity resulting. The incision begins a little below and behind the mastoid process, extends straight down along the outer edge of the trapezius muscle, and then curves forward a little below the middle of the neck, and terminates at the juncture of the sternomastoid muscle and clavicle. Through this incision we are able to remove all of the deep descending chain, including the supraclavicular, the anterior, and the posterior groups. If the submaxillary and the submental groups are involved, a second incision running parallel to the lower jaw, two finger breadths below the lower border, will expose the areas and avoid any important structures, *e.g.*, the lower branches of the seventh nerve. In order to prevent the formation of a wide, ugly scar, it is very essential that we turn back the platysma muscle and the skin



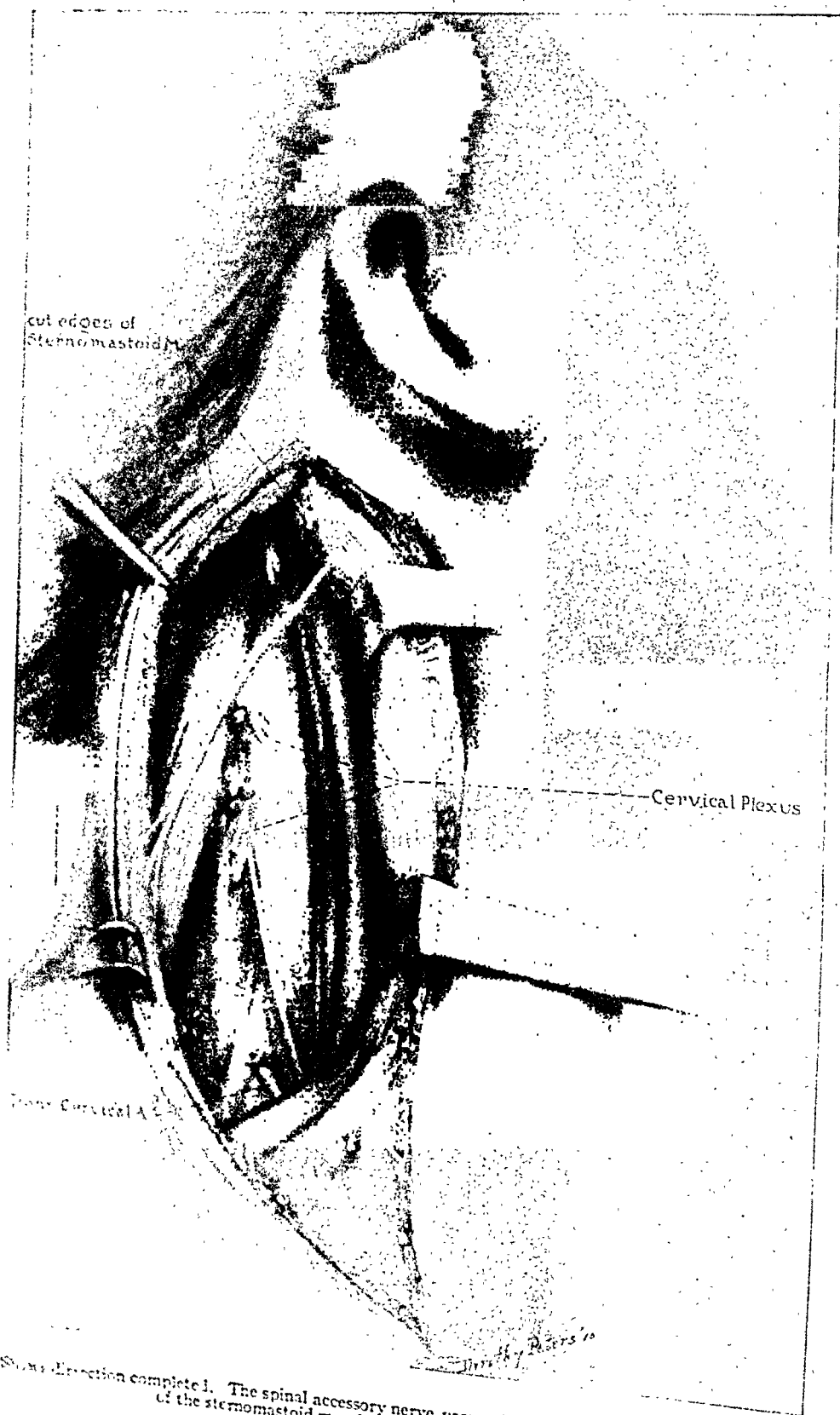
Showing the skin and platysma dissected forward and backward. Retractors under posterior border of sternomastoid, exposing glands lying in gland-bearing fascia. The omohyoid marks the lower applied the dissection, and the mastoid process, the upper. The spinal accessory nerve is partly dissected from among the glands.

FIG. 2.



Showing fascia dissected from the lower angle. Internal jugular vein shown lying beneath the sternomastoid muscle. The phrenic nerve, lying on the scalenus anticus muscle and branching from the cervical plexus, is exposed.

FIG. 3.



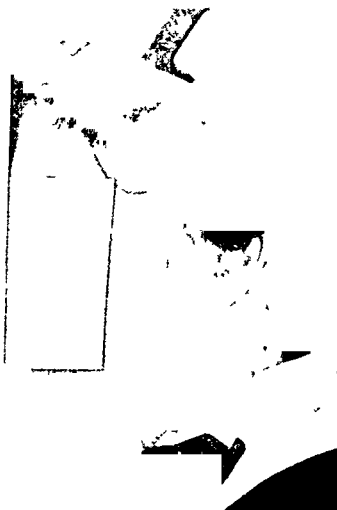
Spinal accessory completed. The spinal accessory nerve passes diagonally across from the upper part of the sternomastoid muscle to the inner surface of trapezius.

FIG. 4.



Photograph taken nine days after operation.

FIG 5



Photograph taken nine days after operation.

Fig. 6.



Photograph taken about two years after operation

Fig. 7.



Photograph taken about two years after operation

FIG. 8.

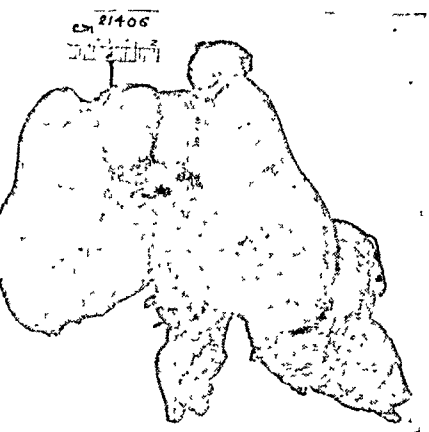


FIG. 10



FIG 9



Figs. 8-10.—Photographs of tuberculous glands after excision.

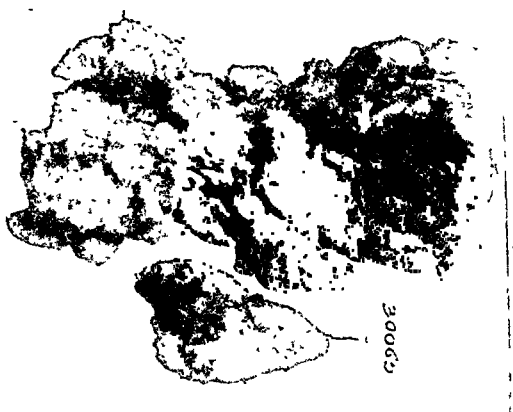
FIG. 11.



FIG. 12.



FIG. 13.



Figs. 11-13.—Photographs of tuberculous glands after excision

in each flap. It is also important that the cut edges in the platysma muscle be sewed together before closing the skin. If these cut edges are allowed to retract, the separation will favor the division of the skin scar. In the past it has not been unusual to see a scar on the neck half an inch to one inch in width (Figs 4 and 5).

It is our custom to drain these cases through a stab incision; this allows the large incision to heal primarily, and we believe this procedure of valuable aid in getting a good scar. The spinal accessory nerve is the only superficial structure that it is necessary to avoid in operating. In many cases the first gland to break down will be the one beneath the spinal accessory as it comes out of the sternomastoid muscle. In several instances we have known the nerve to be cut by simply lancing this broken-down gland. Usually the nerve will be readily found coming out of the sternomastoid muscle one-half inch above the superficial sensory nerves, or it may be identified as it passes into the outer border of the trapezius at the top of the supraclavicular triangle (Fig. 1). If the nerve is accidentally cut it can be sutured at once. It will unite and generally functionate well. If the ends of the nerve are allowed to retract, the deformity will cause a drooping shoulder and an atrophy of the trapezius muscle, which is unsightly and also hampers the use of the arm and shoulder to a considerable degree. We have injured and sutured this nerve on several occasions with no deformity resulting.

In a study of the anatomy of the lymphatics, we observe that tuberculosis invading these glands is likely to be a local process and not an indication of general infection. The entire chain of glands beginning at the subclavian vein and running back to the mastoid process can be removed in one piece without injuring a single important structure. If we consider the glands lying in the cellulo-adipose tissue (gland-bearing fascia) in the neck as a single organ, and treat the mass in a manner similar to that employed in tuberculosis of other organs, our results will be just as good and we will have done as much for the patient as though we had taken out a tuberculous kidney or removed a tuberculous cæcum.

Some years ago it was customary to expect all tuberculous glands to recur. Lymphatic glands and vessels are anatomical structures, and if they are removed we believe are no more likely to recur than a finger is likely to regenerate after it has been amputated. Leaf is alone, I think, in believing that a lymphatic gland will redevelop between the two open ends of lymphatic vessels. In our own cases, we are convinced that the glands which appeared after operation were glands which had not been removed.

During the past fifteen years we have performed 668 operations for complete excision of glands of the neck, 62 operations for partial excisions and curetting, and 24 excisions of tuberculous glands in the axilla in cases which also had tuberculous cervical glands. In all there were 649 patients operated upon on one side at a time. Of these, 19 have since died of pulmonary tuberculosis, and 9 have died of tuberculous lesions elsewhere. Ten of the patients had pulmonary tuberculosis at the time of operation.

In operating upon these cases, it has been our effort to do a radical and thorough excision of the groups involved. Having made the incision from the mastoid to the clavicle, we reflect the skin and platysma well forward and backward. We do not cut the sternomastoid, except a few posterior fibres of its upper attachment on the mastoid process. The entire posterior border of this muscle is freed and the fascia dissected from it. The dissection is started at the lower angle underneath the clavicular attachment. The omohyoid pulley is exposed and this is the lowest point of the dissection. The glands are all left together in the fascia as much as possible (Fig. 2). In some cases the gland-bearing fascia can be dissected with gauze or the finger; at other times, especially if the X-ray has previously been employed, or if considerable resistance has developed, the dense fibrous tissue will necessitate sharp dissection. In freeing the edge of the sternomastoid muscle from below, up about half way we come to the superficial cervical nerves, some of the branches of which turn over and across the muscle. These are purely sensory nerves and

it is best to sever them and get a good exposure. A numbness which persists for some time occurs after cutting these nerves. One-half to one inch above the sensory nerves the spinal accessory emerges from the sternomastoid muscle and passes obliquely downward and outward superficially through the fascia to the trapezius. In carrying the fascia upward, we should, if possible, save the cervical fascia covering the brachial plexus. Traumatism of this plexus will frequently cause considerable suffering. The thoracic chyle duct as it enters the vein should be avoided. It is not uncommon to see the chyle duct on the right side. We have injured this duct during operation in about ten cases; in several instances it healed without causing trouble. In three cases the chyle drained profusely for several weeks and the patients became greatly emaciated. One of them lost 60 pounds; the duct eventually closed, however. All the patients made a good recovery. When the spinal accessory nerve is encountered, it should be dissected free from the fascia and held back while the fascia and glands are turned underneath it. As soon as the internal jugular vein is exposed, it is best to partially occlude its lumen in the lower angle by a gauze pack. This will keep the vein full and prevent sucking of air in case the vein is torn. On several occasions we have heard air sucking into the vein, but have seen no bad results from it. The dissection along the entire jugular vein is sometimes tedious, but we have sacrificed the vein in tuberculous cases in only two instances. Some care should be taken to avoid the phrenic nerve lying on the anterior scalenus muscle. The fascia will lead us directly to the styloid and mastoid. Lymphatic glands within the parotid should be shelled out in a manner that will not interfere in any way with the branches of the seventh nerve. Having completed the dissection, if caseous material has soiled the wound, we mop it out with tincture of iodine well diluted with water; or as suggested by Von Eiselsberg, the entire wound may be mopped for an instant with boiling water. We have never seen any sort of an infection following the spilling of caseous material on the fasciæ (Fig. 3).

Drainage should be provided through a stab incision; we use, preferably, a small rubber tube split spirally. This drain is for the purpose of withdrawing serum and is removed in from 24 to 48 hours. The platysma muscle is carefully sutured with fine catgut, and the skin edges approximated by a subcuticular suture approximating as much of the cut of the skin as possible, giving the appearance of a ridge. In a few days this will smooth down to a line-scar (Figs. 6 and 7). A rather small, snugly fitting gauze dressing is used. The next day the patient is gotten up and encouraged to move the head freely to prevent any stiffening of the muscles. From this time general out-door treatment is advised.

In our series of cases we have had no mortality due directly to the operation. One patient died a few weeks after operation of general tuberculosis, and a second died in about three months from diffuse sepsis (Figs. 8 to 13).

TABLE OF CASES.

Total number of patients operated upon.....	649
Total number of operations.....	750
Average age	25
Number of cases under 10 years of age.....	18
Complete excisions	668
Curetted	62
Both sides operated upon.....	94
Recurrence in region of former operation (8.6 per cent.)	56
Died of pulmonary tuberculosis.....(5 per cent.)	19
Mortality (1 died in 4 weeks, 1 in 3 months, 4 in 1 year, 5 in 2 years, 2 in 3 years, 2 in 4 years, 1 in 5 years, 2 in 6 years, 1 in 8 years).....	19
Died of tuberculous lesions other than pulmonary.....	9
Mortality (2 meningitis, 5 diffuse tuberculosis, 2 tuber- culous peritonitis)	9
Died of other trouble.....	14
Number of patients with pulmonary tuberculosis at time of operation	10

METALLIC FOREIGN BODIES IN A BRONCHUS.*

WITH A REPORT OF TWO CASES.

BY GEORGE RYERSON FOWLER, M.D.,

OF BROOKLYN, NEW YORK.

THE distressing symptoms accompanying and following accidental inspiration of foreign bodies and the changes arising from their presence in the air-passages stamp this class of cases as extremely grave in character, and hence of the greatest importance to the surgeon.

In the early history of the subject it is to be noted that a prejudice existed against the performance of the operation of tracheotomy, through fear that the cartilages would not reunite, and it is to be presumed that many victims to these accidents perished in the early days who might have been saved by a prompt incision of the tracheal rings, an operation which, at the present day, is indicated not only in cases of lodgement of a solid foreign body in the upper air-passages, but also those in which it is situated low down in the respiratory tract.

Metallic foreign bodies in the bronchi form a class by themselves. The advances in methods of diagnosis of metallic foreign bodies in the organism in general made in recent years suggest this classification. The certainty with which the X-rays make the identification of metallic foreign bodies in general possible, and the ease with which the X-ray diagnosis may be verified in the case of those situated in the bronchi by instruments constructed on the principle of the telephonic probe of Girdner constitute a marked advance in the surgery of foreign bodies.

* Read before the New York Surgical Society, Dec. 13, 1905.

EDITOR'S NOTE.—This contribution was found among the manuscripts of the late George Ryerson Fowler and, never having appeared in print, is sent for publication by his sons, Dr. Russell S. Fowler and Dr. Royale H. Fowler.

The question of the point of final lodgement of foreign bodies in the bronchi is of interest in this connection, and here two divisions must be made of the subject. For instance, those that are irregular in shape, such as hooks, safety-pins, etc., and which may lodge at various points above the point where the respiratory tube becomes sufficiently narrow to arrest their further progress, as well as coins and similar objects that may lodge either transversely or be placed on edge and either partially or completely occlude the bronchus, form a group separate from those that are regular and smooth in outline and pass directly to a point where their arrest is coincident with complete occlusion of the bronchus and consequent collapse of the lung beyond the point of occlusion. Further, the question of complete or partial occlusion may turn upon other peculiarities of form of the foreign body. For instance, hollow bodies or those that are tube-like in character, with a continuous lumen and an opening at each end, and which, when placed in the long axis of the bronchus do not prevent the passage of air, such as tracheotomy cannulas, form a peculiar group. Finally, there is another class of tubular metallic foreign bodies in a bronchus that have furnished several examples in the literature, namely, those with one end closed. The most familiar of these is the common pencil cap, a device employed to protect the point of a lead-pencil when carried in the pocket.

As between the two primary bronchi it is the general belief that foreign bodies entering the upper air-passages with few exceptions pass into the right bronchus. This has been attributed to, (1) the greater volume of the right bronchus due to the functional inequality of the two lungs, the left having one lobe less to supply with air than the right; (2) the fact, pointed out by Dr. Goodall, of Dublin, that the septum placed at the lower part of the trachea between the two bronchi is situated somewhat to the left of the median line, as a result of which the lumen of the right bronchus is more directly in the line of the axis of the trachea than the left, and a foreign body in its passage from the trachea will, by virtue of the laws

of gravity, be directed toward the right bronchus; (3) the force of the current of inspired air is greater on the right than on the left side, owing to the inequality of respiratory function of the two sides, this serving to direct the foreign body to the right (Poulet).

In spite of these anatomic and physiologic reasons why the foreign body should find its point of lodgement in the right bronchus in almost every instance, the fact remains that, according to the most conservative estimate, at least one-third find their way into the left bronchus (Gross, Boudillat, and others). On the other hand, Dr. W. B. Cheadle¹ collected from the English journals 34 cases of foreign body in a bronchus, in 30 of which the position of the foreign body was stated. Of these, in 16 it was lodged in the left bronchus, and in 14 in the right. Adding to this 3 cases coming under his own observation, in all of which lodgement took place in the left bronchus, we have 19 cases in the left to 14 in the right. Although this estimate is based on comparatively few cases, the figures are suggestive, at least, of the frequency of the entry of a foreign body into the left bronchus.

Of metallic foreign bodies of tubular form, those with both ends open, and which permit free entrance and exit of air, give rise to an entirely different train of symptoms when arrested in the bronchus from those present when occlusion of the bronchus takes place. The symptoms caused by the passage of the foreign body through the glottic opening and past the vocal cords differ according to the size of the lumen of the object. When the lumen is small the symptoms are practically the same as when a solid body is present, namely, those of impending suffocation due to energetic contraction of the irritated glottic opening and larynx. When the lumen is large the foreign body resting in the glottic opening or in the larynx becomes practically an intubation tube. Likewise when the foreign body is lodged in a bronchus, the differences are marked in direct proportion to the diminution of the calibre of the tubular object and the freedom with which air passes

¹ Medico-Chirurgical Transactions, vol. lxxi, 113.

through the lumen of the latter to and from the corresponding lung. In cases of impaction of detached tracheotomy canulas in the bronchi, the symptoms may be of so mild a character as to lead to a disbelief on the part of the medical attendant in the patient's statements, as occurred in a case recorded by Clement Lucas. Examination of the chest in this class of cases reveals nothing to call attention to the presence of the foreign body. Resonance persists everywhere, and the respiratory murmur is but slightly if at all interfered with, the air passing into the alveoli comparatively unimpeded. The clinical picture presented in the above class of cases becomes more and more striking in contrast with that which is presented in cases of tubular foreign bodies of lesser calibre in proportion to the obstruction offered by the latter to the free passage of air, until, finally, the lumen may be so small as to convert the object into practically a solid foreign body.

On the other hand the lodgement of solid foreign bodies in the bronchi gives rise to a train of characteristic symptoms, these being attributable, first, to the suppression of the function of the corresponding lung, second, to changes in the lung tissue due to collapse of the alveoli, and third, to inflammatory septic conditions following the prolonged presence of the foreign body in the bronchus such as acute followed by chronic bronchitis, pulmonary emphysema, and, rarely, by ulceration of the wall of the latter. Escape of the foreign body into the surrounding lung structure may or may not follow ulceration of the wall of the bronchus, but in any event, with the occurrence of the latter septic pneumonia follows, terminating in abscess or gangrene. The prolonged presence of a foreign body, whether tubular or solid, or partially or completely occlusive, in a bronchus without giving rise to grave symptoms is one of the rarest occurrences in surgical experience.

In connection with the question of calibre it is to be remarked that foreign bodies that obstruct the right bronchus are much more dangerous than those that obstruct the left, for the reason that a much larger respiratory area is compromised. Further, sudden, complete, and permanent occlusion of either

primary bronchus is apt to prove fatal early in the case, for the reason that compensatory action on the part of the other lung cannot be established with sufficient promptness to prolong life.

The following instances of metallic foreign body in a bronchus are brought forward as contributions to the literature of the subject. The special interesting features of the cases relate, first, to the fact that in one of them, as in the case of Clement Lucas, scarcely any symptoms were present to support the patient's assertion that his tracheotomy tube had slipped away and passed "down somewhere" as he stated it, that the case antedated the use of the Röntgen rays in surgery, and therefore the presence of the foreign body was only discoverable by the aid of the telephone probe, and that this accident occurred to the same patient upon a second occasion, with precisely the same absence of symptoms, was identified in the same manner, and removed by the same means. In the other case the presence of the foreign body in the bronchus, likewise metallic and tubular in character, but with one end closed, gave rise to the most pronounced symptoms. In the second case the diagnosis, made by Dr. Linder who was called to see the boy in consultation with the family physician, was verified by the X-rays, and in both cases the steps taken for the removal of the foreign body were greatly facilitated and made both certain and safe by the employment of forceps connected with the telephone receiver in the manner employed in the use of the telephonic probe of Girdner.

CASE I.—Methodist Episcopal Hospital, No. 2982. J. L., age thirty-five, farm laborer, admitted March 14, 1892. A little over a year previously while in a fit of drunken despondency he had attempted suicide by cutting his throat. He had made a number of slashes, but only succeeded in severing the epiglottis and wounding the neighboring soft parts in several places. Owing to the presence of a large amount of cicatricial tissue following the healing, it had been necessary for him to wear a tracheotomy tube ever since. This was made of aluminum. On the night preceding his admission to the hospital he had retired

with the tube intact and in place. Upon awaking in the morning he found the shield part of the tube fastened to the tape about his neck, but the tube itself was missing. He was not conscious of its presence in the air-passages, but supposed it to be there, as he could not account for its absence otherwise.

There was no dyspnoea, no cough, nor other discomfort attributable to the lodgement of the tube in a bronchus. The patient's only anxiety was the fear that he might not recover the tube, and be thereby compelled to purchase another. An examination of the chest organs was negative.

A telephonic probe was improvised by means of the ordinary Bell receiver of the telephone system, a sound gauge served as a large metallic electrode, a long silver probe of the common pattern, and a pair of conducting cords from the battery in the ward completed the apparatus. The circuit through the telephone was completed by moistening the plate with a solution of common salt and pressing it firmly against the surface of the chest wall.

An opening was made in the trachea as low as possible, and with the edges retracted the improvised telephonic probe was passed, first, into the right bronchus, but without encountering the tube. It was then slightly bent at its extremity and again introduced, and directed this time toward the left bronchus. The characteristic grating sound heard in the receiver held to my ear by an assistant showed that the probe was passing over the inner surface of the lost tracheotomy tube.

The probe was then withdrawn and a flexible throat forceps substituted for it in the telephonic circuit. This was then introduced in the direction of the left bronchus. The same grating sound announced its contact with the tracheotomy tube. When the distance travelled by the passage of the forceps was judged to be a half inch greater than the length of the tube, the jaws of the forceps, which up to this time had been closed and partially concealed in the flexible shank of the instrument, were projected and opened, and the forceps withdrawn with the tracheotomy tube strung onto its stem.

The low tracheotomy wound was allowed to heal and the patient was discharged wearing a silver tracheotomy cannula, which he was advised to watch carefully that it did not become loosened from the shield.

In spite of the warning given, and his past experience as

FIG. 1.



X-ray photograph showing pencil top in left bronchus.

FIG. 2.



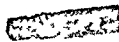
Modified Wells bullet forceps in telephonic circuit, grasping the foreign body.

FIG. 3.



Modified Wells bullet forceps, prongs partly open.

FIG. 4.



Lead pencil cap removed from bronchus.

well, he again applied for admission to the hospital three, and a half years later (October 3, 1895, Hospital Case No. 6281) with the same story of having "swallowed" the tube. On this occasion, however, he was awake when the accident occurred, and was stooping over washing his face when he felt the tube detach itself from the cannula. There was a momentary sense as of something slipping down, but that was all.

The same steps were taken to identify and recover the tube as on the first occasion, and with the same success. When discharged from the hospital on this occasion he was provided with a hard rubber tube, since which time he seems to have had no further trouble.

CASE II.—German Hospital, Brooklyn, Hospital Case No. 7963. W. M., age eleven, school boy, admitted November 6, 1905. Six days before admission, while sucking a metal pencil cap the latter slipped past the back of his tongue. He was seized with a violent fit of coughing and severe dyspnœa. His parents hurried him to a hospital in the neighborhood, where he was given a glass of water to drink. He immediately said that he felt better, and that the pencil cap had gone down, meaning that he had swallowed it. On his return home, however, he continued to have paroxysms of coughing, during which he became very cyanotic.

He was seen at this time by Dr. Linder, who noted labored breathing, the accessory respiratory muscles being called into play, and marked retraction of the left anterior chest wall on inspiration. Percussion showed dulness, amounting almost to flatness, on the left side. Auscultation revealed absence of breath sounds over the retracted area and diminished breathing over the upper left chest. There was tubular breathing over the upper lobe of the right lung. The heart's action was rapid and tumultuous.

A fluoroscopic examination was made and the foreign body found to be situated on the left side and lying in an oblique direction, corresponding to the left bronchus. Its centre apparently rested opposite the sixth rib. Judging from the relations that it bore to the available landmarks of the bony chest wall, and from the fact that some air entered the upper lobe of the left lung, it was estimated that the branch of the left primary bronchus leading to the latter was only partially occluded (Fig. 1).

A duplicate of the pencil cap was procured for the purpose of adapting or constructing an instrument for the removal of the foreign body. The latter was found to be tubular in shape, one and one-half inches long by about a quarter of an inch in diameter, and closed at one end. Near the closed end an ornamental bead had been spun in the metal.

With the aid of Mr. Julius Pfarre, of Tiemann and Company, an instrument was adapted for the removal of the pencil cap embodying the features of flexibility, proper direction of grasp, and a telephonic probe attachment. The instrument known as Wells's bullet forceps was modified for the purpose. The modification consisted in changing the direction of the jaws, so that instead of grasping an object from without as the wire stem within the flexible shank or cannula is pushed forward, as was originally intended, it would grasp a tubular body from within as the stem was withdrawn (Figs. 2 and 3).

On November 8, eight days following the accident, under chloroform, the operation of low tracheotomy was performed, and a half-round section of the tracheal rings on each side of the tracheal wound removed by means of the tracheal chondrotome. The skin on each side of the incision and the corresponding sternohyoid and sternothyroid muscles were sutured together with catgut. This gave ample working room without the necessity for forcible retraction of the edges of the incision. The telephonic forceps was then introduced and directed toward the left primary bronchus. A click followed by a fine grating sound in the receiver at my ear announced that the forceps had entered the tube of the pencil cap. Knowing the shape of the foreign body, no hesitancy was now felt in pushing the instrument onward until its farther progress was arrested by the closed end of the cap. The sliding stem within the cannula-like shank of the instrument was then withdrawn, thus expanding the jaws and engaging these on the inner surface of the tube. Their hold was increased by the presence of the ornamental bead referred to. Once engaged the forceps were slowly withdrawn and with it the pencil cap (Fig. 4).

A tracheotomy tube was placed in position temporarily. This was removed after twenty-four hours, and the wound allowed to close. The collapsed lung slowly expanded, and when examined by Dr. Linder a few days later had practically regained its normal condition.

Remarks.—Instances are not wanting in the literature of the detachment of a tracheotomy cannula from its shield and passage into a bronchus. Tubular foreign bodies have been removed by means of a metallic wire curved like a hook. In a case reported by Adler,² in which a piece of pipe stem was lodged in the right bronchus of a child of seven, the first attempt at removal resulted in transferring the foreign body to the left bronchus, from which place it was recovered on the following day by the above mentioned device.

A device improvised by Helferich³ is worthy of mention in this connection. The foreign body, a metal pencil holder, was located in the left bronchus of a child of six, the situation of which was determined by the X-rays. The operator attached a rubber finger cot to a long tube and passed it into the open end of the pencil holder. The finger cot was then inflated and, thus engaging the tubular foreign body, the latter was removed.

In the very interesting case reported by Dr. Cheadle⁴ the foreign body, which appears to have been somewhat like the pencil cap herewith reported, was likewise lodged in the left bronchus. In this case, as in my own, the tube had fortunately passed with the closed end first, thus leaving the open end presenting. A low tracheotomy was performed and through the opening thus made the forceps used for removing the intubation tube (O'Dwyer) was introduced. The open end of the tube was engaged by the forceps, the blades of the latter expanded, and thus secured the pencil cap was withdrawn.

²Quoted by Poulet (*Treatise on Foreign Bodies*), vol. ii, 43.

³*Zeitschrift für Chirurgie*, lxvii.

⁴*Ibid.*

SARCOMA OF THE CLAVICLE: END-RESULTS FOLLOWING TOTAL EXCISION.*

BY WILLIAM B. COLEY, M.D.,

OF NEW YORK,

Attending Surgeon to the General Memorial Hospital; Attending Surgeon
to the Hospital for Ruptured and Crippled; Professor of
Clinical Surgery, Cornell Medical School.

THE first case of total excision of the clavicle for sarcoma was the famous case of Valentine Mott, operated upon on June 17, 1828, and published in the *American Journal of the Medical Sciences*, 1828, vol. iii, p. 100.

In Mott's case the tumor had been first noticed in February, 1828, and, as in my own case, followed shortly after a strain. The tumor was treated for a considerable time with plasters, poultices, a seton, and escharotics. At the time of operation it was 4 inches in diameter, of "incompressible hardness," and a portion of it was covered with fungous granulations. Mott gives a very detailed description of the operation. He states that "the patient lost some 16 to 20 ounces of blood, that the tumor was about the size of a man's doubled fist. It consisted of a bony cup, was incompressibly hard at all parts, except superiorly and inferiorly to a small extent. From an elliptical opening in the upper part, protruded a bleeding fungus, the size of half a hen's egg." He states: "This operation far surpassed in tediousness, difficulty, and danger anything which I have ever witnessed or performed. It is impossible for any description which we are capable of giving to convey an accurate idea of its formidable nature. The attachment of the morbid mass to the important structure of the neck and shoulder of the left side, and to so great an extent, is sufficient to indicate its magnitude and difficulty." The wound healed by granulation. It is interesting to note Mott's statement that "the immense chasm which was left, and such impor-

* Read before the American Surgical Association, May 3, 4, 5, 1910, at Washington, D. C.

tant parts as have been described only covered with lint, necessarily occasioned great solicitude until suppuration was fully established and the great vessels covered by granulations."

Mott states that by means of an apparatus contrived by Mr. James Kent, a most ingenious and inventive artist, to supply the want of the clavicle, he was so fitted as to have his shoulder in its proper position, at the same time that the full motion of his arm was preserved.

Comparatively few cases of total excision of the clavicle for malignant diseases have been reported by American surgeons. G. Norkes,¹ in 1893, published a case observed at Brun's Clinic, and made a very careful analysis of the cases reported in the medical literature up to that time. He found 31 cases of total excision for non-malignant and 32 for malignant tumors, of which 24 were sarcoma, 5 carcinoma (?), 2 exarthrosis, and one chondroma, with 6 deaths. It is probable that the cases put down as carcinoma were sarcoma, as primary carcinoma of the clavicle is practically unknown. Only one case died of septicæmia. Warren's case died four weeks afterward, of pleuritis or possibly metastases. Langenbeck's case died six days later from a swelling of the dura mater; Politz's case died on the eleventh day, from brain tumor, Sajous's on the eighth day, of fascial metastases; in Eves's case the cause of death was doubtful.

The immediate results in the majority of cases as regards usefulness of the arm were remarkably good. In many cases, without the use of apparatus of any kind the patients were able to use the arm as well as before.

As regards end-results, the statistics of Norkes are extremely deficient; only 2 cases are known to have lived and remained well beyond two years.

Since the publication of Norkes's paper in 1893, I have been able to find in the medical literature reports of 20 additional cases. Adding to these 10 thus far unreported cases, which have come to my notice through personal communica-

¹ Beitr. z. klin. Chir., 1893, Band xi, p. 729.

tions from the surgeons who performed the operations, we have a total of 62 cases.

It is with special reference to the following unpublished cases and especially those which have come under my own observation that this paper has been written.

CASE I.—*Sarcoma of the clavicle; round-celled; total excision* (author's case). J. V., male, aged 16 years.

Family History.—Good.

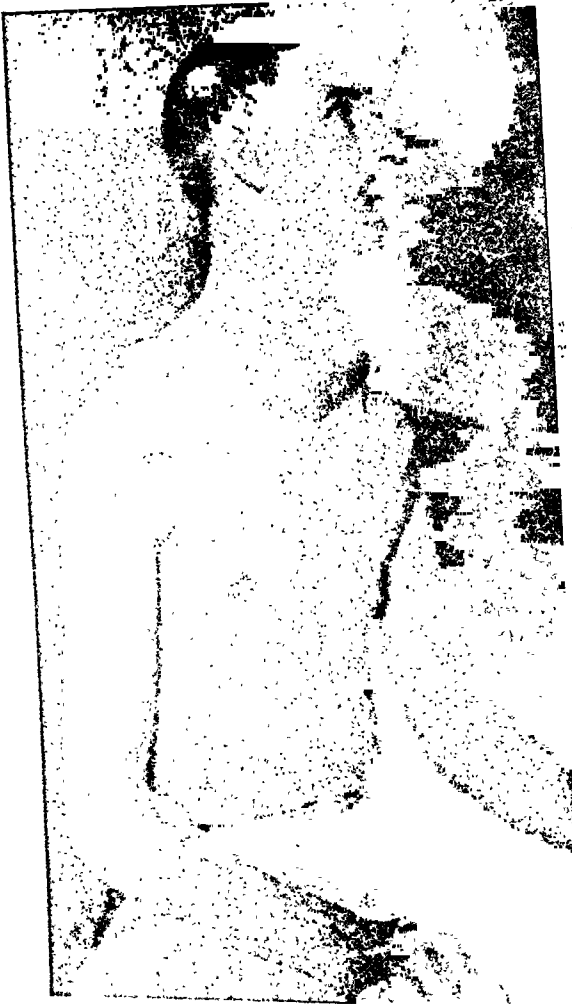
Past History.—Always well until the beginning of October, 1909, when, going down stairs he tripped and fell. Trying to save himself, he caught hold of the banister with his left hand, which brought him up so suddenly that it caused a good deal of strain upon his left shoulder and clavicle. Shortly after that, while riding a motor cycle, the latter broke down and he was obliged to tow for a distance of ten miles, during which time he held on to the tow iron with the left hand. End of October, he first noticed pain and soreness in the region of the left clavicle, but did not notice any swelling until a week later. He consulted Dr. Alfred Potter, of Brooklyn, November 20. Dr. Potter found a fusiform enlargement of two-thirds of the inner portion of the shaft of the left clavicle. He had an X-ray made which presented the appearance of a typical periosteal sarcoma. The outline of the periosteum was very nearly lost; no enlarged glands were present. The tumor was about the size of an English walnut. The patient's general health was good; there was very little pain. The clinical history, physical signs, and the X-ray photograph made the diagnosis of sarcoma sufficiently certain, in my opinion, to warrant removal without subjecting the patient to the danger of an exploratory incision. Accordingly, two days later, November 22, 1909, with the assistance of Dr. W. A. Downes, I performed the operation of total excision of the clavicle. The incision was made over the outer surface of the clavicle over its entire length, and after separating periosteum and bone, Gigli's wire saw was passed beneath the clavicle one and a half inches from the outer extremity, well beyond the tumor. The inner and larger portion was then lifted up and dissected from the subclavian muscle and separated from its attachments until the sternocostal articulation was reached. Disarticulation was then accomplished with little difficulty and no hemorrhage. The outer

FIG. 1.



Total excision of clavicle for sarcoma of three weeks' duration in a boy aged sixteen years (Coley).

FIG. 2.



Recurrent sarcoma of clavicle six months after operation.

FIG. 3.



Sarcoma of clavicle of nine months' duration.

portion of the clavicle was thereupon removed by a rongeur forceps. The wound was closed, leaving a small cigarette drain. The patient made an uninterrupted recovery, the wound healing by primary union, and left the hospital at the end of ten days. Before leaving the hospital, he was put upon the mixed toxins of erysipelas and *Bacillus prodigiosus* in small doses, which were steadily continued by his family physician for a period of three months; the patient then considered himself so well that he refused further treatment. At the present time, November, 1910, almost a year after operation, the patient is in perfect health.

CASE II.—*Sarcoma of the clavicle; total excision* (DR. M. H. RICHARDSON) followed by one year's treatment with the mixed toxins; patient well two years and a half. J. W. H., aged 34 years.

Family History.—Father died of cancer of the stomach; no tuberculosis in family.

Past History.—Six or seven years ago a plank fell over and struck the patient upon the left clavicle, nearly knocking him down. He first noticed a swelling of the clavicle in January, 1908. A few weeks later, slight pain developed. He consulted a physician on January 19, 1908, who said he was unable to make a diagnosis. The swelling continued to increase slowly, and March 23 he consulted Dr. Hunt, of Bangor, Maine, who said it was sarcoma. The diagnosis was concurred in by Dr. S. W. Johnston, of Belfast Maine, who referred the patient to Dr. Maurice H. Richardson, of Boston. The latter did a total excision May 18, 1908. The tumor occupied the middle and inner thirds, and operation was difficult. Microscopic examination showed it to be small, round-celled sarcoma. As soon as the wound healed, Dr. Richardson referred the patient to me for the toxin treatment as a prophylactic against recurrence. At this time there was considerable infiltration in the whole lower cervical region, which was very suggestive of either a recurrence or incomplete removal. This gradually cleared up under the toxins and had entirely disappeared at the end of two months. The treatment was carried out under my direction by the family physician, Dr. H. L. Trulock, of Dixmont, Maine. The dose was gradually increased until he received 20 mm. Examination was made by myself in February, 1909, as also in July and October, at which time he had gained twenty-six pounds in weight and was in perfect health. The same is true at the present time, two years after operation. Dr. Richardson stated that he considered the absence of a recurrence in this case entirely due to the toxin treatment.

CASE III.²—DR. THOS. W. HUNTINGTON'S case (San Francisco, California, September 5, 1908). Mr. X., Pinole, California.

Family History.—Negative. Lues, negative; habits exceptionally good.

Past History.—Never had any serious illness. For the past eighteen months has been under Dr. Huntington's care for double salivary fistula.

²Dr. Huntington has kindly given his permission to include this unpublished and very important case.

Case not clearly made out and due to stenosis of Stenson's duct. One sinus is still open.

History of Present Trouble.—In September, 1906, while carrying a steel shaft with a fellow workman, his companion dropped his end, whereby Mr. X. sustained a severe contusion or bruise of the right clavicle at the junction of the outer and middle thirds. An enlargement at this point appeared within the next two or three weeks. This remained stationary for many months, but never wholly disappeared. Four months ago it began to grow quite rapidly, attaining its present size one month ago, since which time it has remained stationary.

Present Status.—The skin over the outer portion of the clavicle is reddened superficially, the area of redness covering a mass which is clearly associated with the shaft of the clavicle. The mass appears to be about the size of an ordinary English walnut, slightly elongated at the ends. The mass is indurated and irregular in outline. Fundus of the mass is clearly fluctuant. The largest diameter of this mass is fully twice that of the clavicle shaft. On examination the sensation conveyed is that the mass contains a fluid content in the centre, the outer portion remaining crater-like. It is sensitive upon pressure, but otherwise is painless. The patient's general health is fairly good, and he seems, thus far, not to show any general deterioration.

Operation, September 8, 1908.—At the University Hospital, Dr. Huntington resected the entire clavicle, removing a segment of skin overlying the centre of the tumor. Macroscopic appearance of the tumor verified the conditions outlined above. The tumor had undergone a degeneration in the centre. Contents, thick grumous material. The margins of the tumor arose from the periosteum, and though the shaft itself was involved, the pathological report was to the effect that the tumor was spindle-celled sarcoma of periosteal origin. The shaft of the bone had participated in the process secondarily. The operative wound was left open in the centre, but healed slowly by granulation after a period of nearly three months. At the end of two weeks, treatment by Coley's toxins was begun and continued for about five months.

On April 12, 1910, the patient was in excellent condition. Both parotid fistulas had been closed for many months.

Cases IV and V.—MR. GILBERT BARLING'S cases, Birmingham, England (personal communication). (1) Miss S., aged 10 years, May, 1901. An injury to the left clavicle, doubtful fracture, probably not, but it seems likely that some swelling has existed in the region of the clavicle ever since that injury. When seen by me on January 22, 1902, a mass the size of the fist over the left clavicle, apparently fluctuating in parts, skin adherent and rather dusky, veins very much dilated; the swelling extended from half an inch outside the sternoclavicular joint nearly to the outer end of the clavicle; no swelling of the arm, no numbness or loss of power in the arm.

Diagnosis.—Sarcoma. Removal advised, but operation is not one that could strongly be recommended.

January 28, 1902: Complete removal of the left clavicle. There was very troublesome bleeding from small vessels but no injury to the large

veins. It was noticed that there was a good deal of cedema over the growth, as though it were of an inflammatory nature. The thoracic duct was injured, and chyle escaped into the wound but not in any large quantity. The small opening in the duct was closed by a lateral ligature.

The patient made a good recovery, but on February 1, 1902, it was noticed that there was a good deal of milky fluid escaping from the wound; this continued for several days in gradually diminishing quantities. The patient was up ten days after the operation.

Note on September 2, 1902: There was extensive recurrence in and around the scar impossible for removal. The patient died a few months afterward.

(2) *Spindle-celled sarcoma of the clavicle.* Seen April, 1889. Male, aged 33 years. Growth had existed several months and there was a fracture through the middle of it, produced probably by the manipulations of a bone setter who had been treating the patient. The growth was mainly of the inner half of the clavicle, was firm in consistence, without evidence of cystic formation.

Operation, April 12, 1889.—The operation went well, there was no injury to any of the big vessels, but there was straightaway infection of the wound and the patient died on the fourth day after the operation from suppuration extending down the mediastinum and giving rise to pleurisy.

CASE VI.—Sarcoma of the clavicle, periosteal; total excision (HARTLEY); recurrence three months after operation. G. M., aged 19 years.

Family History.—Good.

Past History.—No trauma.

First noticed a small lump above the left clavicle in March, 1907. He thinks it was movable at first, and states that it disappeared. A month and a half later the swelling reappeared and seemed to be attached to the clavicle. He consulted a physician, who treated him for rheumatism for a number of months. The tumor continued to increase in size. In April, 1909, he went to the New York Hospital and was admitted to the service of Dr. Frank Hartley, who did a total excision. The microscopic examination was made by Dr. Elser, who reported the disease to be a spindle-celled sarcoma. Three months later the patient noticed a local recurrence above and below the former site of the scapula. The patient was then referred to me, and I had him admitted to the General Memorial Hospital, September 28, 1909. By this time the patient had several recurrences occupying the whole upper portion of the right chest; the recurrent masses varied in size from a marble to three to four inches in diameter, and were situated beneath the pectoral muscle. Several smaller lumps had also appeared underneath the old scar and pectoral region (see illustration). The toxins were begun in small doses and gradually increased up to 14 minims. After two weeks there was considerable decrease in size of the various nodules and increased mobility. Shortly after that, however, the control was lost and the tumors again began to increase in size. December 1, 1909, it seemed useless to continue the treatment, and the patient was discharged from the hospital unimproved.

CASE VII.—*Round-celled sarcoma of the clavicle.* E. S., male, aged 21 years. In May the patient broke his left clavicle. One year afterward a swelling appeared at the site of the fracture and grew rapidly. The clavicle was partly removed by operation, but the disease quickly returned, soon involving the scapula. The patient was treated by myself with the mixed toxins for about four weeks, but without success. Excision of the remaining portion of the clavicle, the entire scapula, and upper extremity was later performed by Dr. W. W. Keen, of Philadelphia. The patient recovered from the operation, but died eight months later from a recurrence.

The following cases of sarcoma of the clavicle I have personally observed, but no operation was done on account of the extent of involvement when first seen.

CASE VIII.—*Sarcoma of the clavicle, recurrent; trauma.* W. F., male, aged 38 years.

Family History.—Always well until December, 1908, when he swung from trolley car, grasping rail by left hand. Immediately thereafter pain set in over the inner third of the clavicle; this subsided, but a week later he noticed a bony lump which he thought was the overlapping of the collar-bone. This tumor slowly increased in size, and three to four weeks later he consulted a surgeon who sent him to the Long Island College Hospital, where the diagnosis of tumor of the left clavicle was made. Operation was performed on February 5, 1909. The wound healed by primary union and the patient left the hospital on February 28. A week later he noticed a lump in the suprasternal fossa; this was painless, but gradually increased in size, and he returned to the hospital March 28. The treatment with the mixed toxins was begun, but discontinued after a few weeks, as there was no appreciable improvement. When I saw him a few weeks later the growth was so very extensive and signs of metastasis were already evident that I abandoned further treatment.

CASE IX.—H. K., aged 31 years.

Family History.—Good.

Past History.—In May, 1897, carried a heavy piece of steel on the right shoulder; one month later he noticed a lump directly over the clavicle at the point where the steel rested. The first

operation was done by Dr. Mayer, of Buffalo, in July, 1897, who removed a gland below the clavicle, the size of an English walnut; three weeks later a lump appeared in the axilla and rapid involvement of the surrounding tissues quickly followed. When I saw the patient, February 16, 1898, his general condition was very poor; he was confined to the bed most of the time; his right arm was greatly swollen down to the tips of the fingers. The whole neck and shoulder were occupied by an enormous tumor extending to the sternum in front and nearly to the vertebral column behind; the skin over the tumor was of a deep purplish color and the patient was unable to move the arm at the shoulder. No treatment advised:

Prognosis.—Six weeks to two months of life.

CASE X.—J. L., male, aged 8 years.

Family History.—Negative.

Past History.—Had a bad fall from a stone fence in October, 1905, injuring right shoulder and clavicle. Soon after a small lump formed in the clavicle; this was very soft and was supposed to be an abscess by his physician, who lanced it. End of December there was a recurrence, and in January, 1906, an exploratory operation was performed by Dr. Bodine, but it was impossible to remove the entire tumor. There was rapid increase of the disease thereafter and evidence of lung involvement. The patient was seen by me in March, 1906. Physical examination at this time showed the patient much emaciated; respirations, 40; pulse, 120 to 130; the right lung was nearly solid, and a large tumor in the region of the right clavicle infiltrated the adjoining tissues.

CASE XI.—T. B., male, aged forty-six years; good family history; antecedent trauma dislocation of shoulder. In June, 1902, he first noticed a stinging pain in the inner portion of the left clavicle. Shortly afterward, a small enlargement was noticed in this region. He began X-ray treatment under the direction of Prof. J. Collins Warren, in November, 1902, and continued until March, 1903, two to three times a week, with considerable diminution in size of the tumor. In October, 1903, a specimen was removed by Dr. Warren and found to be round-celled sarcoma. The X-ray treatment was then resumed and continued until February, 1904, with the result that the tumor almost entirely disappeared. Later, however, it began to increase again

in size and a third series of treatments was begun in August, 1904, and continued until October, 1904, with little effect. In October, 1904, the patient was referred to me by Dr. Warren for the mixed toxin treatment. Physical examination at this time showed a pear-shaped tumor, occupying the sternal portion of the left clavicle, $2\frac{1}{2} \times 5\frac{1}{2}$ in. in diameter, occupying about two-thirds of the inner portion of the clavicle. The skin was normal and not adherent. The glands above and below the clavicle were somewhat involved, and there was slight enlargement of the left arm. The mixed toxins were administered in the pectoral region and buttocks from October 6 to November 26, 1904, during which time 31 injections were given in doses ranging from $\frac{1}{2}$ to 4 minims, with moderately fair reactions, the temperature ranging between 99° and 102° . The X-ray treatment was given in conjunction with the toxins, three times a week. At first there was slight retardation of the growth, but later there was no apparent effect; the tumor again continued to increase in size and the treatment was abandoned. The patient grew worse steadily and died about a year later.

CASE XII.—H. B., male, age twenty, electrician. Family history good. No single trauma but accustomed to carrying heavy materials upon left shoulder, *e.g.*, iron pipe.

Pain in shoulder for more than a year before any tumor was noticed. Small tumor first observed on outer portion of left clavicle in January, 1910. Operation (Dr. Stewart, Newport, R. I.) March, 1910. Tumor size of English walnut removed from outer end of left clavicle. Clavicle itself not resected. Microscopical examination showed tumor to be round-celled sarcoma, periosteal. Recurrence in three weeks. Very rapid growth followed. Patient under my care at General Memorial Hospital September 15 to October 20, 1910. Mixed toxins given in as large doses as deemed safe. Result little or no effect in controlling growth. Treatment discontinued. Prognosis, two or three months of life.

THE DIAGNOSIS OF SARCOMA OF THE CLAVICLE.—That the diagnosis of cancer of the clavicle must be made early if there is to be a probability of saving the patient, a study of the collected cases makes very clear. It is true that Mott's case was far advanced, but it was of central origin, not of the more

malignant periosteal type. No variety of tumor is more malignant than many of these cases of periosteal sarcoma of the clavicle. The proximity of large vessels insures an abundant blood supply, and consequently we have early infiltration and very rapid generalization.

That the diagnosis of sarcoma of the clavicle in the very early stages is possible is shown by my own case, in which total excision was performed three weeks after the swelling was first noted.

A distinct history of antecedent trauma was noted in 7 of the 9 cases of sarcoma of the clavicle personally observed. In most cases there was a history of a swelling having been noted a short time after the receipt of an injury. This swelling is intimately connected with the bone, of hard, firm consistence, not usually the "bony hardness" described by Mott, but often there is a slight yielding on deep pressure; the skin is normal in the early stages; later there may be dilated veins, but it is never adherent to the deeper structures except in the very late stages—too late for any attempt at operation. Pain is usually absent. The neighboring glands are seldom enlarged.

X-ray examination is of very great aid in diagnosis, especially in tumors of central origin. In most cases of periosteal sarcoma the X-ray plate will show a fairly characteristic picture. The sharp outline of the bone is nearly always lost, although I have just had a case of periosteal sarcoma of the femur in the early stages, in a girl aged twenty years, in which the outline was absolutely distinct, the probable explanation being that she was seen at such an early stage that no infiltration of the bone proper had taken place as yet.

One must differentiate the condition from tuberculosis. A history of tuberculosis in the family, or evidence of tuberculosis in the glands or some other portion of the body, would justify one in ruling out sarcoma. It is extremely rare to find primary tuberculosis of the clavicle. Sarcoma is prone to occur in strong and healthy individuals—more often in the young or middle-aged than the elderly.

Syphilis.—A history of syphilis may usually be elicited by

careful questioning; in addition, a physical examination would probably show other bones than the clavicle affected. Besides, a syphilitic tumor would be of much slower growth.

Myositis Ossificans.—This in itself is a rare condition, and I do not know of any cases that have occurred in the clavicle. The X-rays would be of very great help in making the differential diagnosis.

If clinical history, physical examination, and X-ray findings all point to sarcoma, shall we then cut into the tumor and remove a section for microscopic examination before performing the operation of complete or partial excision of the clavicle? In most cases, I should say "no"; at least, I would prepare for the major operation, and, in case of doubt, would have a microscopic examination made from the frozen section at the time of operation. But, in some cases—my own among the number—it is impossible to make a satisfactory examination from the frozen section, for the reason that decalcification of the bone must first be made.

To one who has had large experience in operations upon sarcoma of the bones, macroscopic examination of the tissue, together with the clinical history and physical signs, will, in nearly all cases, be sufficient to make an error of diagnosis exceedingly rare. Therefore, in a rapidly growing tumor of the clavicle, I would perform total or partial excision, according to the condition found in the individual case, without waiting for the result of a microscopic examination. In some cases it is possible to make frozen sections at the time of operation which might be of some value.

After operation, as soon as the wound has sufficiently healed, I would very strongly urge prolonged treatment with the mixed toxins of erysipelas and *Bacillus prodigiosus*, as a prophylactic against recurrence.

In the cases thus far reported, there has been an early recurrence in the great majority of cases that have been traced. Only three cases are known to have been well beyond a period of three years.

The prophylactic treatment with the toxins is entirely free

from danger and can easily be carried out by the family physician.

Of course, it would be unscientific to claim that, because a number of cases of sarcoma in which the toxins had been used after operation remained free from recurrence, this result was due to the use of the toxins. Unless the number of cases were very large, such results might be explained by coincidences, without any relation of cause and effect. Yet the fact that in the cases of sarcoma of the long bones generally, in which the toxins have been used, recurrences have been less than one-third as frequent as in the cases in which they were not used, would seem to justify the conclusion that the treatment played some part in lessening the number of recurrences.

I did not advocate the toxins as a prophylactic after primary operation for sarcoma until comparatively recently, and not until I had seen a large number of cases of inoperable sarcoma entirely disappear under the treatment and remain permanently cured. If the toxins can cause a disappearance and final cure in such far-advanced, inoperable cases of sarcoma, a logical and entirely reasonable inference is that the toxins used after primary operation would be still more likely to destroy the few infected cells left behind that form the basis of future return.

The influence of trauma upon the development of sarcoma, and, in fact, upon the development of all types of malignant tumors, is a question which has elicited much discussion pro and con. Phelps, in the *ANNALS OF SURGERY*, June, 1908, made an elaborate attempt to disprove any causal relationship between trauma and the development of cancer; he limits the discussion to carcinoma.

For more than twenty years I have made a very careful study of the relationship between injury and the development of malignant tumors, and I have become more and more firmly convinced that injury plays a most important rôle in such development, both in sarcoma and in carcinoma. These cases of sarcoma of the clavicle show more strongly than any others, perhaps, the intimate connection between an antecedent trauma and the sarcoma. The association of the injury with the

rapidly following development of the tumor would appear far too striking to be easily explained away as a mere coincidence.

Trauma.—Of the 9 cases of sarcoma of the clavicle there was history of trauma in 7 of the cases, and in one of the two remaining cases the patient had carried heavy weights upon the clavicle in which the sarcoma developed.

Case I: Sarcoma of the left clavicle; a heavy plank fell upon the left clavicle six years before.

Case II: Sudden severe strain of shoulder while getting off a trolley car; immediate pain; tumor noticed one week later; operation four to five weeks later.

Case III: Severe strain of clavicle from grasping banister to prevent falling down stairs; tumor noticed one week later.

Case IV: Dislocation of shoulder; tumor of clavicle noticed two to three months later; round-celled periosteal.

Case V: Fractured clavicle; tumor appeared one year later at exact site of fracture.

Case VI: Had a fall from stone fence, striking on clavicle; tumor appeared almost immediately after.

Case VII: No trauma.

Case VIII: Bruised by carrying heavy bars of steel upon shoulder and clavicle; tumor developed at the exact site, one month later.

Case IX: An electrician, and habitually carried heavy materials upon shoulder of side in which sarcoma developed.

ANALYSIS OF THE CASES.—As regards the age of the patients, in 1 case the sarcoma was noticed at birth; 2 cases were between one and ten years; 19 cases were between ten and twenty years; 9 cases were between twenty and thirty years; 12 cases were between thirty and forty years; 7 cases were between forty and fifty years; 1 case was between fifty and sixty years; 3 cases were between sixty and seventy years.

As regards the type of the growth in the successful cases: Mott's case was probably of central origin, well fifty years; Wheaton's case, type not stated, well ten years; Norkes's case, myeloid growth, well five years; M. H. Richardson's case, periosteal growth, well two years; Huntington's case, peri-

osteal growth, well two years; my own case, of central origin, well seven months.

RESULTS OF OPERATION.—Eleven cases died from the effects of the operation. In 1 case there was a recurrence four years after operation; in 1 case there was a recurrence eighteen months after operation; in 1 case a sarcoma of the femur developed three months after operation; in 1 case there was a local recurrence six months after operation; in 1 case there was a recurrence soon after; in 1 case there was a recurrence in the upper jaw nine years after operation; 1 case was well five months later; 1 case recurred a few months later; 1 case recurred within three months; 1 case recurred within two months. In these 10 cases recurrence was noticed within the first six months in 7 cases; 1 recurred in four years, 1 in eighteen months, and 1 in nine years. Six cases were well at the time of the last observation: Mott's case was well fifty years; 1 case well ten years; 1 case well five years; 1 case well two years; 1 case well one and one-half months; 1 case well seven months. In 3 of these cases the toxins were used immediately after operation as a prophylactic (Richardson's, Huntington's, and my own). In the remainder of the cases the final results are not known.

CONCLUSIONS.—1. Primary sarcoma of the clavicle, while a rare condition, requires very early diagnosis and very early radical treatment—total or partial excision as soon as the diagnosis has been made.

2. The mortality of the operation performed under modern aseptic conditions should be very small.

3. The danger of early local or general metastases is very great.

4. In view of the favorable results obtained in the few cases of sarcoma of the clavicle, and the much larger number of cases of sarcoma of the long bones in general, by the use of the mixed toxins of erysipelas and *Bacillus prodigiosus* immediately after operation, as a prophylactic, such use would seem to be strongly indicated as a routine measure.

TABLE OF REPORTED CASES OF SARCOMA OF CLAVICLE.

No.	Reporter.	Date.	Reference.	Sex and Age.	Site.	Duration.	Description.	Operation.	Type.	Result.	Final report.	Remarks.
1	Mott	1829	Amer. Jour. Med. Sci., 1828, iii, 100	M 19 L	Beneath and adherent to clavicle	.....	Size of two fists	.....	Osteo. with ulceration	Recovery	Well 50 years	
2	Warren	(1832) 1837	Surg. Obs. of Tumors, p. 405	M 24 R	Inner end	.....	.....	Total excision	Pulsating	.....	.....	Died of pleurisy 4 weeks after Trauma
3	Travers	1838	Med. and Surg. Trans., xxi, 135	M 10 L	Inner end	1 year	.....	Total excision	Osteo.	Recovery	Well 6 mos.	
4	Liston	1844	Lancet, p. 361	M ....	.....	.....	.....	Total excision	Soft	Recovery	Recurred in 3-4 months	
5	Chaumet	1849	Gaz. Med. de Paris	F 18 L	Outer	9 months	Size of fist	Resection of external four-fifths	.....	Recovery		
6	Gallardon	1847	Gaz. des Hop.	F 45 ..	Middle, sternum, 1st rib	.....	.....	No operation	Vascular pulsating	.....	.....	Died of broncho-pneumonia
7	Rigaud	1850	Gaz. Med. Strasbourg, A. X., p. 103	F 15 L	Inner	7 years	Size of fist	Resection of inner two-thirds	.....	Recovery		
8	Owens	1854	New Orleans M. and S. J., xii, 64	.....	.....	.....	.....	.....	.....	.....	.....	Doubtful
9	Langenbeck	1855	Deutsch. Klinik	F 11 L	Both ends	.....	.....	.....	Spindle cell	Died on 6th day		
10	Syme	1857	Ed. Med. J., iii, Pt. I, 192	F 20 ..	Outer end	.....	3½ x 4½ cm.	Total excision	Osteo.; myeloid cells; cystic	Recovery		
11	Cooper	1858	Gaz. de Hop.	... L	.....	.....	.....	Total resection	.....		
12	Esmäreck	1850	Nissen. Diss. de resect. Killae	M 33 R	.....	.....	Size of a hen's egg	.....	.....	Recovery	Recurrence; died in 4 yrs.	

13	Notation	1860	Thesis de Paris	F 146 R	Inner end and sternum	2 years	.....	.....	Myeloid	.....	.....	Died of bronchitis
14	Gosselin	1861	Bull. Soc. de Chir., 2d series, ii	M 37 R	Inner third	.....	Size of a lemon	Resection of inner third	Fibrous elements	.....	.....	Fracture
15	Peau	1861	Gaz. de Hop., p. 419	M 37 ..	.....	.....	Size of a citron	.....	Spindle cell	.....	.....
16	Notation	1863	Bull. Soc. Anat., 2d series	F 30 ..	Middle	.....	.....	.....	Fibrous and fibroplastic	.....	.....
17	Richet	1864	Dict. de Med. et de Chir. Pratiq., viii	M 65 R	Inner third	2 years	.....	Resection of inner third	Myeloid	.....	Recurred 18 months after in scar	
18	Paquet	1867	Bull. de la Soc. Anat., p. 634	M 21 R	Inner end sternum, 1st rib	6 months	12 x 8 cm.	No operation	Embryonic and myeloid	.....	Died	
19	Delors	1868	Gaz. Med. de Lyon, iii, 93	.....	Inner end	.....	.....	.....	Medullary carcinoma	Recovery	Doubtful	
20	Morin	1868	Ibid.	Child	.....	.....	.....	.....	Carcinoma	.....	Doubtful	
21	Meyer	1869	Gaz. Med. de Lyon, No. 8, p. 93	.....	.....	.....	.....	.....	.....	.....	Doubtful	
22	Seign and Fve	1869	Chicago Med. Exam., x, 653	M 12 L	End	14 months	.....	Vein injured at operation	.....	.....	.....	Cervical glands enlarged; died from exhaustion
23	Cooley	1870	St. Louis Med. Jour., p. 62	M 30 L	Middle	.....	.....	.....	.....	Recovery	.....
24	Britton	1870	Brit. Med. Jour., i, 518	M 35 L	Outer end	2 years	Size of an orange	Resection of all except acrom. end.	.....	Recovery	.....
25	Fve	1871	Nashville Jour. Med. and Surz., i, 68	M 13 L	.....	7 months	Size of an ovary	.....	Enchondroma (red, flesh-like)	Died	.....	Doubtful; spontaneous fracture
26	Richet and Depondre	1873	Paris Thesis	F 51 L	Outer end	3 months	Size of an orange	Resection of outer end	.....	.....	.....

No.	Reporter.	Date.	Reference.	Sex	Age	Site.	Duration.	Description	Operation.	Type.	Result.	Final report.	Remarks.
27	Tausini	1883	Gaz. degli Ospitali, F Milano, No. 39, p. 306	F	30	Inner end	.....	Size of an egg	.....	Myxœdema	Healed in 15 days		
28	Deprès	1885	Bull. de Soc. de Chir., F pp. 143-226	F	14 R	Outer end	.....	Size of an orange	.....	Central	In hospital 31 days		
29	Segoud	1885	Ibid.	M	66	.....	.....	.....	.....	.....	Died on 8th day of vis- ceral in- volvement		
30	Pollcaillon	1885	Bull. de Soc. de Chir., M p. 146	M	16 R	Outer end	18 months	Size of fist	Resection of external three-fourths	.....	Recovery	Well 3 months died of sar- coma of femur	
31	Kronlein and Ritter	1885	Inaug. Diss. Zurich	F	17 L	Central part	.....	.....	Total resec- tion	Periosteal; round cell	.....	Prompt re- currence; well 10 yrs.	
32	Wheeler	1885	Trans. Acad. Med. of Ireland	M	43 L	.....	.....	.....	.....	.....	.....	.....	Slight blow; phthisis; imp.; well 10 years later
33	Sloan	1887	Am. Jour. Med. Sci., M p. 485	M	14 R	.....	.....	.....	.....	Carcinoma (?)	.....	Recurred 6 months after	Doubtful
34	Heath	1888	Lancet, i, 721	M	30 L	Outer end	3 years, 10 months	.....	.....	Spindle and round cell	7 days after operation developed br. symptoms	Died on 11th day	
35	Chiene	1888	Lancet, i	F	15	.....	.....	.....	.....	.....	.....	.....

36	Wiescher	1890	Horp. Tiden de Kop-M enhagen, Feb., i, 310	M 29	.....	.....	.....	.....	Myelogenous	.....	.....	Soon recurred	
37	Rosen	1899	Lancet, i, 575	M 29	Inner end	.....	Size of an egg	Resection of inner two- thirds	.....	.....	Died of sepsis	.....	Vein injured
38	Forest	1899	Lancet, p. 1077	F 18 R	Inner end	.....	.....	.....	.....	.....	Healed in 2 months	.....
39	Harlan	1893	Brit. Med. Jour., p. 813	M 31	.....	.....	.....	.....	Periosteal; round cell	.....	Primary union	Well 5 mos.	
40	Garré-Norkus	1893	Refranz, sur. Klin. Chir., ii	F 31 R	Outer end	.....	2 in. long	Total excision	Myeloid; pul- sating	.....	Immediate recovery	Well 5 years	
41	Curtius-Norkus	1893	Am. Jour. Med. Sci., xxxiv, 350	F 20 L	.....	.....	.....	.....	Osteosarcoma	.....	Recovery	.....	Probably syph- ilitic
42	Leguen	1893	Bull. Soc. Anat.	F 23	.....	.....	Nut	Total excision	.....	.....	.....	.....	Pulmonary tu- berculosis
43	Courlin	1897	Gaz. Hbd. des. Se. Med. de Bordeaux, xviii	F 23 L	Middle and inner end	.....	.....	.....	Osteo.	.....	.....	Lived 1 mo.	
44	Verrucato	1898	Jour. de Se. Med. de Lille, i	M 40 R	Middle and inner end, 1st and 2d ribs	.....	Size of an orange	Total resec- tion	Subperiosteal; encapsulated	.....	Recovery	.....
45	Henson	1898	Ibid.	M 39 R	External end	.....	Size of an egg	Total excision	Myeloid; periosteal	.....	.....	.....	Operated on 9 years before for sarcoma of superior max- illary
46	Flament	1898	Ibid., ii	M 10 R	External two- thirds	.....	Size of an egg	Resection of external two-thirds	.....	.....	Recovery	Well 1 month	
47	Dourg	1902	Paris Thesis	M 45 R	Middle and inner end	.....	Size of an orange	Total resec- tion	.....	.....	.....	.....

No.	Reporter.	Date.	Reference.	Sex.	Age.	Site.	Duration.	Description.	Operation.	Type.	Result.	Final report.	Remarks.
48	Jonnesco	1903	Bull. et Mem. Soc. de Chir. de Bucarest, vi, 253	...	L	.....	.....	.....	Total resection	Osteo.	Recovery	.....	Fracture; multiple fractures of ribs; died before operation; weighed when removed 1600 grams
49	Degonville	1904	Paris Thesis	M	50	L Middle third	2 years	.....	.....	Myeloid and round cell	.....	.....
50	Kryukoff	1904	Russk. Vrach., St. Petersburg, iii, 775	F	12	R	.....	.....	Total resection	Round cell	.....	.....
51	Buteanu	1905	Bull. Soc. de Med., et Nat. de Jassey, xix.	...	...	.....	.....	.....	.....	Osteo.	.....	.....
52	Coley	1909	Unpublished	M	16	L Middle portion, myelogenous, round-celled	6 weeks	Size of an English walnut	Total resection followed by toxins	Periosteal	Recovery	Well at present, 1910; one year later	Toxins almost immediately after operation
53	Huntington, Thos. W.	1908	Unpublished	M	39	R Outer and middle third	2 years	English walnut in size	Total resection followed by toxins (Coley)	Spindle-celled periosteal	Recovery	Well 2 years	Followed a blow
54	Gilbert Barling, Birmingham, Eng.; personal communication	1889	Unpublished	M	33	... Inner half	Several months	.....	Resection	Spindle-celled	.....	Died on 4th day from suppuration of mediastinum and pleurisy	Fracture through middle of bone
55	Ibid.	1901	Unpublished	F	10	L Middle and inner portion	.....	.....	Total excision	.....	.....	Recurred 9 months after, in scar; died a few months later	

44	Richardson, M. H.; personal communication	1899	Unpublished	M 34 L	Middle and inner third	4 months	.....	Total excision followed by toxins (Coley)	.....	Recovery	Well 2 years; Plank fell over striking patient and 2 mos.
47	Hartley, Frank	1909	Unpublished	M 19 L	.....	2 years	.....	Total excision	.....	Recovery	Recurred in 3 months in side of chest
53	Keen, W. W.	1894	Unpublished	M 21 L	.....	.....	.....	First operation partial; second, inter-scapular thoracic amputation; toxins	.....	Recovery	Died 8 mos. later, from recurrence
59	Hodgins (Coley)	1906	Unpublished	M 8 R	.....	3 months	.....	First, lancing of abscess; second, partial removal of tumor	Periosteal; round-celled	.....	Death in a few months
60	Warren, J. Collins (Coley)	1902	Unpublished	M 46 L	.....	6 months	.....	No operation; toxins; X-ray	Periosteal; round-celled	.....	Died 1 year later
61	L. I. College Hospital	1909	Unpublished	M 38 L	Inner third	1 week	.....	Operation (?) Partial removal	Rapid growth	Recurrence week later in suprasternal fossa; toxins then given with but little benefit	Trauma; dislocation of shoulder Strained shoulder
62	Stewart (Coley)	1910	Unpublished	M 20 L	Outer third	2 months	Tumor size of English walnut, outer end of clavicle	Operation: Dr. Stewart, Newport, R. I., March, 1910	Periosteal; round-celled	Recurrence 3 weeks; very rapid growth	Mixed toxins (Coley) Sept. 15, to Oct. 15, 1910; no effect on very large tumor
63	Coley	1898	Unpublished	M 31 R	Outer end	9 months	Tumor of enormous size	General condition very bad; prognosis, few weeks of life			No single trauma, but habitually carried iron pipes and heavy material on left shoulder

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TRANSGASTRIC EXCISION OF CALLOUSED ULCER OF THE POSTERIOR WALL OF THE BODY OF THE STOMACH.

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GASTROJEJUNOSTOMY has proved an efficient means of relief for calloused ulcers which lie in the pyloric end of the stomach and are obstructive in character; but for the considerable number of cases in which the ulcer is located at some little distance proximal to the pylorus, this operation is often inefficient, and, at best, gastrojejunostomy leaves a cancer possibility which cannot be ignored.

It has been shown by Robson, Moynihan, and others, that gastrojejunostomy, though it gives relief to symptoms, does not protect the patient from later carcinomatous degeneration.

Three hundred resections have been performed in St. Mary's Hospital (Sept. 23, 1910). Two hundred and sixty-three of this number were subjected to careful examination in order to determine in how many of the cases cancer had its origin in ulcer, and it was shown definitely that 71 per cent. of the gastric cancers had developed on gastric ulcer.

The frequency with which malignant disease develops upon gastric ulcer leads to the conviction that chronic calloused ulcer of the stomach is treated best by excision, and in excising, if mechanical conditions are created which interfere with the progress of food, gastrojejunostomy for the purpose of drainage should be done as a supplementary procedure.

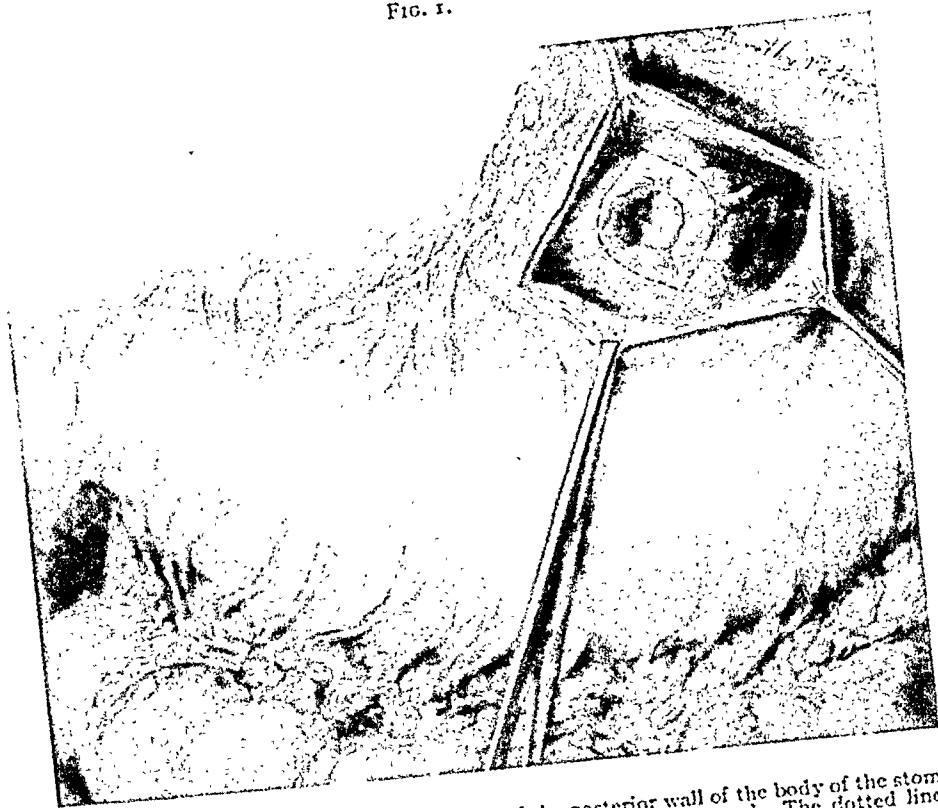
For ulcers lying in the pyloric end of the stomach, the Rodman operation is efficient, i.e., partial gastrectomy with complete closure of the end of the duodenum and stump of the stomach, and independent gastrojejunostomy. This procedure is a rational application to a new field of the

Billroth operation number two for gastric cancer, and we have used the method a number of times with great satisfaction.

In saddle ulcers of the lesser curvature, excision may ordinarily be performed without difficulty, and the excision of an ulcer of the anterior wall of the stomach may be easily accomplished, but in the type of ulcers which occur on the posterior wall of the body of the stomach, which are so often adherent to the pancreas and other retrogastric structures, excision is most difficult. In several instances where there was hour-glass contraction, we have succeeded in making a resection in continuity with end-to-end anastomosis of the divided stomach ends.

There are a number of posterior ulcers, however, in which none of these operative measures can be applied satisfactorily, and in such cases we have succeeded in making a transgastric excision of the ulcer through the anterior wall of the stomach. Our first transgastric excision of a calloused ulcer of the posterior wall of the body of the stomach was the result of an immediate necessity to meet an accidental complication. A male, forty-eight years of age, was found to have calloused ulcer of the posterior wall of the stomach about four and one-half inches above the pylorus. The ulcer was adherent to the pancreas, which formed the ulcer base. An opening was made through the gastrohepatic omentum, and an attempt made to separate the ulcer from the pancreas; hoping thus to bring it into view through the opening in the gastrohepatic omentum and excise it, or to perform a resection in continuity. These manipulations resulted in partially separating the ulcerated surface posteriorly, with immediate leakage of the stomach contents behind into the lesser cavity of the peritoneum. The gastric opening was plugged with a finger, the gastrocolic omentum opened below, and with some difficulty adequate protection was secured about the ulcer. It was impossible to get a view of the ulcer either from above or below, therefore the anterior wall of the stomach was opened to the extent of three and one-half

FIG. 1.



Transgastric excision of calloused ulcer of the posterior wall of the body of the stomach, showing anterior wall of the stomach open and the ulcer exposed. The dotted lines show proposed site of excision.

FIG. 2.



Ulcer excised, and the through-and-through mucous suture partially completed.

FIG. 3.



Anterior wall of the stomach sutured. Rubber-tissue drains in place.

inches in its long axis, and by retraction of the margins of the opening, a splendid view of the ulcer was obtained. The ulcer was excised with a knife, leaving it attached to the pancreas, from which situation it was shaved cleanly off. The cut margins of the posterior wall of the stomach were sutured from the mucous side by means of a running suture of heavy linen thread applied transversely to the long axis of the gastric cavity. The anterior wall of the stomach was closed with chromic catgut and linen. An attempt was then made to apply a peritoneal suture behind to cover the row which had been applied from the mucous surface. It was quickly seen, however, that serious damage would result in an attempt to secure the necessary exposure. Further examination revealed that the single through-and-through suture which had been applied from the mucous surface made a most satisfactory union without reinforcement. Three drains, composed of rolls of rubber tissue, were passed behind the stomach to the line of sutures to cover the site on the pancreas where the ulcer had been excised. These drains were brought out through the upper angle of the abdominal incision. There was no leakage or drainage, and the patient made a prompt and permanent recovery.

Connell, Coffey, and others have proved, clinically and experimentally, that the single suture is safe, and in the various instances in which we have applied the single through-and-through suture from the mucous surface, the result has been satisfactory.

We have performed the transgastric operation for removal of adherent calloused ulcers of the posterior wall of the body of the stomach five times, without leakage or evidences of infection, and with the recovery of the patient in each instance. The steps of the operation are as follows:

The gastrohepatic and gastrocolic omenta are opened above and below the ulcer. Gauze protection is introduced, adhesions are carefully separated, and, if possible, the ulcer surface is cut free from the posterior attachments without opening the stomach. A piece of gauze is packed into the

denuded area behind, and in all but one of our cases this temporary pack was adequate to stop hemorrhage without the ligation of vessels. The anterior wall of the stomach is opened, and with the fingers behind, the entire ulcerated surface is pressed through the anterior incision and the ulcer excised (Fig. 1). The gap is sutured with through-and-through sutures of chromic catgut from the mucous side transversely, and this suture line is further protected by several mattress sutures of linen, applied from the mucous side to prevent separation due to the early absorption of the catgut (Fig. 2). The anterior wall of the stomach is then closed. Several rubber-tissue drains are carried down behind the stomach and brought out at the upper end of the abdominal wound as a safeguard (Fig. 3).

NOTE.—Dr. Lewis S. Pilcher informed me recently that in May, 1907, he made a transgastric excision of the posterior wall of the stomach in a similar manner, with a successful outcome. A report of the case was published in the *Long Island Medical Journal* of May, 1908, p. 187.

RELATION BETWEEN APPENDICITIS AND DISTURBANCE IN THE GASTRO-DUODENOPANCREATIC PHYSIOLOGICAL SYSTEM.

A REPORT ON THE EXAMINATION OF 5000 APPENDICES WITH A COMPARATIVE STUDY OF THE PATHOLOGY AND CLINICAL HISTORIES IN 2000 CASES.

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THE possibility of an etiological relationship between the appendix and pathological conditions in the stomach, duodenum, liver, bile passages, and pancreas arose as the result of an investigation of the embryology, anatomy, and physiology of these organs in view of clinical experience and pathologic findings in studying the material from 216 gastrectomies,¹ 365 cholecystectomies,² 5000 appendectomies,³ three duodenal ulcers² (autopsy), and the experimental experience of Cannon,⁴ Littbauer,⁵ Tsunoda,⁶ Roger,⁷ and others, all of which, when taken together, strongly suggest that the appendix is at least a part of the etiology of conditions which have been and are being treated as local conditions but which may possibly arise secondarily.

The material for this investigation was furnished by the clinics of Drs. C. H. and W. J. Mayo, and E. S. Judd, St. Mary's Hospital, Rochester, Minnesota.

Embryology teaches us that the stomach, duodenum, liver, gall-bladder, and pancreas are developed from a small segment of the primitive alimentary tract, and that the parenchyma of these organs as well as the stroma, nerves, lymph- and blood-vessels are derived from these structures in the primitive digestive tract.

Anatomy reveals the same blood and nerve supply for these organs that existed when they were a part of the simple primitive tube.

Physiology demonstrates the remaining necessity for products of digestion to pass in contact with the same alimentary cells (now the liver and pancreas) with which they came in contact in the primitive individual.

Autopsy has shown that duodenal ulcers when they occur at or near the papilla of Vater are sometimes, if not always, associated with cholecystitis, and occasionally with chronic interstitial hepatitis (cirrhosis).

The first case, No. 27,238, was a male aged 60 years, who was operated upon for cholecystitis seventeen months before the last operation. He was improved for five or six months, and again had epigastric pain, jaundice, and vomiting. At the second operation, which was performed at St. Mary's Hospital, the gall-bladder was found distended, the common duct dilated, and the head of the pancreas very hard. A note at operation stated that, if a third operation should be necessary it should be cholecyst-enterostomy. The patient died on the twelfth day after operation. Post-mortem examination revealed a marked cirrhosis of the liver, chronic catarrhal cholecystitis (strawberry gall-bladder), chronic pancreatitis, chronic congestion of the spleen, and a chronic ulcer of the duodenum at the ampulla of Vater, about 1 cm. in diameter. There was almost complete stenosis of the common duct in the base of the ulcer.

The second case, No. 31,049, was a male, aged 58 years, who, four years before examination, had attacks of severe epigastric pain which radiated to the back. Seven weeks before the last operation he had similar attacks accompanied by vomiting. At operation the gall-bladder was drained for cholecystitis with one stone, and a hard mass was felt at the end of the common duct, which was thought to be carcinoma of the head of the pancreas. On the fourth day after the operation the patient died from a hemorrhage into the bowel, associated with tarry stools and hæmatemesis. At autopsy a duodenal ulcer 2 cm. in diameter was found. The lumen of the common duct extended apparently unobstructed through the base of the ulcer.

The third case, No. 31,501, a male, aged 56, had his first

attack of pain in the epigastrium three months before examination. The pain was referred to the right costal arch. A week later he had severe pain in the same region. This was accompanied by slight jaundice, no vomiting, but fever and constipation. He suffered from gas belching, bloating, and headaches. At operation a large stone was removed from the neck of the gall-bladder, which it obstructed. The patient had a fatal hemorrhage into the bowel. At autopsy an ulcer of the duodenum was found.

Clinical experience presents strong evidence that there are gastric disturbances which are relieved and often completely dissipated by the removal of the appendix.⁸

Experimental physiology and pathology demonstrate that partial obstruction of the common duct is followed by cirrhosis of the liver;⁶ and that irritants in the large bowel cause retardation of the muscular rhythm of the stomach and intestines;⁴ and that experimental gastric ulcers which do not heal can be produced by trauma plus anæmia but not by trauma alone.⁵

Examination of the appendices removed in association with "pyloric spasm,"* gastric and duodenal ulcers, cholecystitis and cholelithiasis shows that there is a higher percentage of appendices with partially or completely obliterated lumina† in all of these conditions, than at general autopsy or at operation for appendicitis.

Specimens examined at autopsy and operation showed the following percentages:

Autopsy in	2549 cases,*	17	per cent. partially or completely obliterated
Pyloric spasm	17 cases,	17	per cent. partially or completely obliterated

* "Pyloric spasm" has been used clinically to denote an indefinite, apparently functional disturbance in the stomach evidenced by indigestion, pain, bloating, and dyspepsia.

† Obliteration of the lumen of the appendix is practically universally accepted by pathologists to-day to be the result of a mild or acute inflammatory process. The increase in the percentage of the obliterated or partially obliterated lumina does not increase gradually with the increasing decade. The greatest increase and the greatest activity in the process occur during the period in which appendicitis is most common.⁹

Appendicitis 1005 cases, 23.5 per cent. partially or completely obliterated
Gastric and duo-

denal ulcers 52 cases, 26.9 per cent. partially or completely obliterated

Cholecystitis 57 cases, 52 per cent. partially or completely obliterated

Cholelithiasis 118 cases, 44.8 per cent. partially or completely obliterated

In the previous studies² it was found that 23.2 per cent. of 365 cases in which cholecystectomy was performed showed symptoms which began at or under twenty-five years of age, the period during which appendicitis is most common, and that 13 per cent. of these cases gave definite histories of pain and soreness in the region of the appendix. In 59 of these cases of cholecystitis the appendices were removed, and 69 per cent. showed undoubted gross or microscopical evidence of inflammation, varying from a chronic catarrhal condition to complete obliteration and periappendicitis.

In the examination of 2000 appendices with their histories, 52 per cent. of 175 cases of cholecystitis with and without stones gave histories of pain in the region of the appendix.

In 1147 histories, which include all the cases of appendicitis and appendices removed during operations for conditions other than cholecystitis with or without stones, there was a history of pain in the epigastrium or right hypochondrium in 13 per cent. In 9.4 per cent. there was pain in the "abdomen" and in 14.6 per cent. pain in the "abdomen which radiated to and became localized in the region of the appendix."

The ages of patients at onset of symptoms of appendicitis, pyloric spasm, duodenal ulcer, gastric ulcer, cholecystitis, and cholelithiasis are as follows: 23.5 (1005 cases), 24.2 (18 cases), 31 (30 cases), 35 (10 cases), 34.7, and 33.8 years respectively. These conditions come to operation in the same order at the ages of 25.5, 34, 41, 48, 39.6, and 39.9 years. This order is exceedingly important if subsequent observations on a larger series of cases confirm it.

It is the rational course of events to be expected upon the hypothesis that irritation in the appendix and cæcum reflexly cause gastric and duodenal disturbances, which in turn interfere with the mechanism of secretion, storage, and outflow

of the bile, thereby producing conditions favorable for bacterial infection in these organs and the gall-bladder.

A consideration of the average duration from the onset of symptoms to operation, in appendicitis, cholecystitis, and cholelithiasis, reveals respectively 2, 4.9, and 6.5 years. It will be seen that the average duration in cases of cholecystitis lies between the average in appendicitis and cholelithiasis.

The question arises, is this a mere coincidence especially when we know that simple cholecystitis precedes gall-stones? Is there any relationship between these conditions? Are we dealing with a process which manifests itself in three stages, namely, appendicitis, simple cholecystitis, and cholecystitis with stones?

The average age at the onset of symptoms in these three conditions is also of interest, although there is not the same parallel. In appendicitis it is 23.5 years, in cholecystitis 34.7 years, and in cholelithiasis is 33.8 years. There is one thing to be considered, however, and that is the fact that the symptoms in cholelithiasis are likely to be more sudden and severe and therefore demand earlier attention than in simple cholecystitis.

There is a marked contrast between the percentage of appendices with partially or completely obliterated lumina at general autopsies and at operations for appendicitis, and that found in appendices which have been removed in association with cholecystitis and cholelithiasis. Twenty-three and five-tenths per cent. at operation, 17 per cent. at autopsy, and 52 per cent. in association with inflammation of the gall-bladder, have partially or completely obliterated lumen. Eight and seven-tenths per cent. of 2000 appendices were associated with cholecystitis.

In spite of the fact that a higher percentage of males were operated upon for appendicitis than females (55.5 per cent. males and 44.5 per cent. females), partial obliteration of the lumen occurred more often in females (55.2 per cent. females and 44.3 per cent. males). This may be one of the coincidents which lead to false deductions in all statistics, but the

figures are sufficiently significant to be kept in mind as possible evidence of the probable fact that the inflammatory processes in the appendix cause disturbances in the bile passages directly or indirectly, in view of the fact that cholecystitis is decidedly more frequent in females than in males.

These figures, which are the result of examination of the histories and specimens of 2000 cases in which the appendix was removed for appendicitis primarily or secondarily to other abdominal conditions, are sufficiently important, not to prove, but to stimulate, a careful study of clinical histories with relation to the possibility that chronic inflammation in the appendix reflexly disturbs the gastro-duodeno-hepaticopancreatic physiological system, thereby bringing about conditions whereby such lesions as gastric ulcer, gastric carcinoma, duodenal ulcer, cirrhosis, cholecystitis, cholelithiasis, and pancreatitis may be indirectly produced.

During the examination of histories and surgical reports of upper abdominal conditions in which a high percentage of appendices had obliterated or partially obliterated lumina, it was thought that perhaps the technical difficulties in removal of an appendix through a high incision might influence the percentage, in view of the surgeon's ability to recognize such pathologic lesions in the appendix by palpation more readily than less extensive conditions. With this possibility in view, all of the upper abdominal conditions which were not apparently gall-bladder conditions were studied with the following results. In this series there were 46 upper abdominal incisions with 15 (32 per cent.) partially or completely obliterated appendices. For comparison those cases of lower abdominal incisions were taken and in 223 cases, 85 (38 per cent.) appendices were partially or completely obliterated. In 275 cases in which the stomach, duodenum, gall-bladder, and pancreas were explored and reported negative through the lower abdominal incision (straight or muscle splitting), 99 (36 per cent.) of the appendices were either partially or completely obliterated. In all of the upper abdominal conditions examined through high incisions and in the cases reported

negative through low incisions, there were apparently symptoms in the epigastrium which required investigation.

This is merely more clinical evidence that individuals who present a higher percentage of obliterated or partially obliterated appendices at operation do have symptoms referable to the epigastrium, and that the percentage is lower when no recognizable pathologic lesion was found than in cases in which definite changes were found. They are all suggestive enough to demand further experimental evidence upon the subject, and until they are disproven the surgeon should remove the appendix in all cases of chronic appendicitis and in association with lesions in the gastro-duodeno-hepatico-pancreatic physiological system when such an operation can be done with little or no extra risk to the patient. During laparotomies the appendix should be removed when such procedure does not materially add risk to the operation.

By this means there is a great possibility of reducing the number of lesions in that physiological system.

A careful study of the subsequent histories of all cases operated upon for appendicitis should be made in order to determine what percentage of them have developed gastric ulcer, gastric carcinoma, cholecystitis, cholelithiasis, cirrhosis, and pancreatitis.

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THE TECHNIC OF APPENDICOSTOMY.*

A CONSIDERATION OF THE PRESERVATION OF THE BLOOD SUPPLY OF THE
APPENDIX IN THE OPERATION.

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SINCE Weir, in 1902, first ingeniously utilized the appendix for the purpose of irrigating the colon, the operation of appendicostomy has undergone many changes of technic.

The steps in the ideal, which is also fortunately the average case, are:

(a) Abdominal incision, preferably the intermuscular of McBurney.

(b) Turning out the appendix, and, when necessary, straightening it by releasing its mesentery while preserving its vascular supply intact.

(c) Suture of the cæcum adjacent to the appendix to the parietal peritoneum, carefully avoiding obliteration of any cæcal vessels.

(d) Closure of wound about the appendix.

I wish to emphasize the importance of steps *b* and *c* inasmuch as I had the misfortune of having the appendix slough in one of my cases which is detailed below. Moreover, upon inquiry I found that my experience was not unique, but that several colleagues had had a similar experience.

Mrs. X., age forty, weight 240 pounds. Health always good except for an attack of dysentery eight years ago. During the month prior to consulting me she suffered from severe diarrhœa, the dejecta gradually assuming a bloody character, and were accompanied by severe cramps and tenesmus.

Examination was difficult. Through the proctoscope the sig-

* Read before the American Proctologic Society, June, 1910.

moid prolapsed markedly, was ulcerated, and bled freely. No amœba were found. In spite of rest in bed, suitable hygiene, constitutional and local treatment over a period of three weeks, the patient did not improve and appendicostomy was proposed and accepted. I operated at the New York Polyclinic Hospital, March 21, 1908. The gridiron incision was employed, the meso-appendix tied off in part, and the cæcum at the base of the appendix sutured to the parietal peritoneum. While doing this the needle accidentally punctured one of the cæcal arteries going to the appendix and it was tied. The wound was closed in the usual way. Three days later the appendix sloughed, and after a septic temperature of ten days a large mass of fascia came away. Convalescence was uneventful from that time, but the two inevitable sequelæ followed, viz., fecal fistula and hernia. The former closed in due time, but the latter still requires an abdominal belt. The colon yielded to irrigations through the fistula and the patient is well to-day except for the hernia which cannot easily be repaired because of the loss of fascia and the obesity of the patient.

This experience stimulated the writer to a study of the circulation of the appendix from the surgical stand-point. To gain a comprehensive idea of the appendix as of any other part of the intestinal tract, one must refer to embryology.

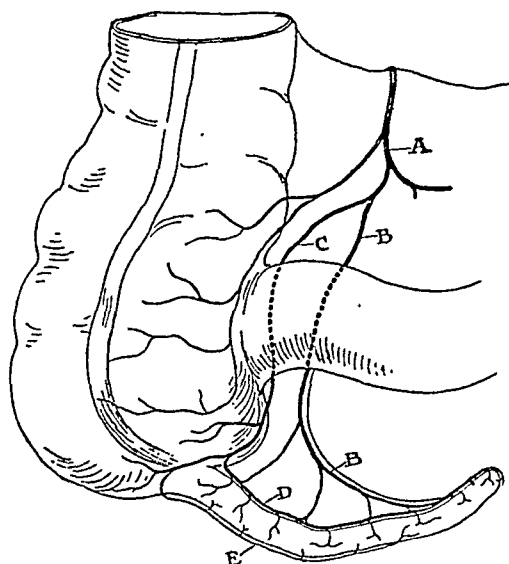
According to Huntington,¹ "The differentiation of the small from the large intestine, marked by the appearance of the cæcal bud or protrusion, takes place in the ascending segment of the umbilical loop a short distance from the apex. In the human embryo the cæcal bud appears in the sixth week as a plainly marked protuberance, which grows very slowly in length and circumference. It shows very early an unequal rate of development; the terminal piece not keeping pace in growth with the proximal portion is converted into the vermiform appendix, while the proximal segment develops into the cæcum proper."

Minot² states that "At six months the appendix is long and slender, *with a narrow free mesentery*, and is relatively much better developed than in the adult and is also less sharply marked off from the cæcum proper."

Briefly, then, the appendix is the vestige of the original head of the cæcum which failed to participate equally in development with the rest of that organ, and at a period prior to the sixth month of embryonal life, not possessing a mesentery, derived its sole blood supply from the cæcal vessels. The latter statement also holds true for the rudimentary and fetal forms of appendix, even in adults.

The vascular supply of the appendix is usually as follows: the descending branch of the colica dextra forms an anas-

FIG. 1.



A, posterior ileocæcal artery (partly schematic); B, appendicular branch; C, cæcal branch; D, constant, and E, variable branches from cæcal to appendix.

tomosing loop with the ascending branch of the ileocolic. From this loop the anterior and posterior ileocæcal arteries spring and are so named from their relation to the ileum. The former supplies the anterior surface of the ileum and lower cæcum but sends no branch to the appendix.³ The posterior ileocæcal artery (see Fig. 1) passes back of the ileum close to the cæcum, and sends branches to ileum, lower colon, posterior cæcum, and appendix. The appendicular branch comes off from the posterior ileocæcal near its origin. The cæcal branch courses over the inner and back wall of the cæcum close to the appendix, to which it sends one or more branches.

These two branches, then, of the posterior ileocæcal, viz., the appendicular and the cæcal, are for all practical purposes the sole blood supply of the vermiform appendix.

Parenthetically it must be remarked that the so-called ligament of Clido, the occurrence of which is denied by many anatomists and surgeons, but which according to that author exists in 10 per cent. of women, is a negligible quantity in connection with appendicostomy, since the appendicular artery which it is supposed to contain anastomoses with mesenterioilar-appendicular branches.

The branch from the cæcal above noted is constant and courses along the appendix on its mesenteric side, anastomosing with branches of the appendicular, while occasionally a smaller branch runs beneath the peritoneum opposite the attachment of the mesentery.

The appendicular artery divides into several mesenteric branches, usually three to five, of which the largest runs in the free border of the meso-appendix. It is for this reason that perforation is apt to occur where the mesentery ends from gangrene of the tip beyond this point.⁴ In a number of dissections made by the writer on injected subjects this arrangement of vessels was found regularly. These observations are in accord with the statement of Poirier, Charpy, and Cuneo⁵ viz.: "It is to be noted that this last artery (the appendicular) has slight anastomoses only with the cæcal arteries; it is almost terminal and its obliteration should involve the necrosis of the appendix."

Remembering, then, that the cæcal branch is the earliest and a constant source of blood supply to the appendix, and that the mesenteric branch is the more abundant in nearly all adults, also that the anastomosis between these vessels is very limited, they being somewhat terminal in character, the precarious nature of the arterial stream to the appendix became evident at once as well as the importance of not interrupting the current of either the cæcal or the mesenteric branch at operation if the vitality of the appendix is to be maintained entire. In a given case where the anastomosis is unusually free, either branch

might be tied without danger, but at operation this point cannot be determined accurately, so the only safe clinical rule in practice is to respect and preserve both vessels.

At operation when uniting the cæcum adjacent to the base of the appendix to the parietal peritoneum, no difficulties are presented in avoiding the cæcal branches, as, fortunately, these vessels indicate their position by visible pulsation.

The mesenteric branches, however, require separate consideration. In some instances the appendix is so straight and the mesentery so narrow that it can be fixed in the wound at once. Most appendices, however, are falciform, as the mesentery is shorter than the appendix. To render their lumen fairly straight for the irrigating tube, it is necessary to free the mesentery. There are two ways of accomplishing this. One is to ligate and cut the mesentery at a point sufficiently distal from the base of the appendix that the blood supply is preserved to that portion of the appendix which traverses the abdominal wall. This method insures a viable organ up to the skin surface, but is open to the objection that the tip becomes gangrenous early and infection is apt to extend between the appendix and abdominal wound.

The other method, which is the one here advocated and in practice found free from objections, allows the appendix to be straightened sufficiently while preserving the vessels intact. Dr. Tuttle has applied this method in all his recent cases with marked success. It is accomplished by separating the two layers of the mesentery at its juncture with the posterior mural peritoneum, beginning at its free border, and carefully displacing the cellular tissue with its contained appendicular artery and branches as far as necessary toward the appendix. The two layers of peritoneum are divided transversely up to the base of the appendix, turned in, and sewed to obliterate the raw space on the posterior abdominal wall. It is unnecessary to test at once the patency of the lumen as advocated by some surgeons. This step adds an element of danger from infection. However constricted the lumen at first, it readily dilates to sufficient size. The danger is not that the calibre will be too

small, but rather that it will be too large and leak fæces. Another great advantage of leaving the appendix intact till the wound has healed is that it may then be amputated about one centimetre from the skin, the teat-like prominence thus left giving easy entrance to the tube.

Further precautions are not to obliterate any arteries by ligatures, sutures, forceps, tension or torsion in fixing the appendix in a position where it does not rest naturally, or compression by closing the abdominal wound too snugly about it.

Bearing these points in mind, the operation of appendicostomy is on a par with an interval appendectomy as regards technic, speedy convalescence, and safety, the mortality being nil in my series of cases. Postoperative leakage of fæces and hernia, the two troublesome sequelæ of appendicostomy, are also avoided.

By practising this improved technic I am confident that results will be so satisfactory that appendicostomy will continue to grow in general favor over cæcostomy in all cases where prolonged irrigation of the entire colon is indicated.

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ANOMALOUS RENAL ARTERIES AND THEIR RELATION TO HYDRONEPHROSIS.

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THE following variations are reported with a two-fold object: first, to discuss in some detail the more common irregular types of the arterial supply to the kidney; second, to call attention to the relation of such variations to operative procedures on the kidney and their importance as a causal factor in the development of deformities of the pelvis and ureter.

The variations herein reported were found in subjects dissected in the Anatomical Laboratory of the University of North Dakota. Our records include too few subjects to attempt any statistical conclusions at present, but the following cases illustrate the more common types of variation.¹

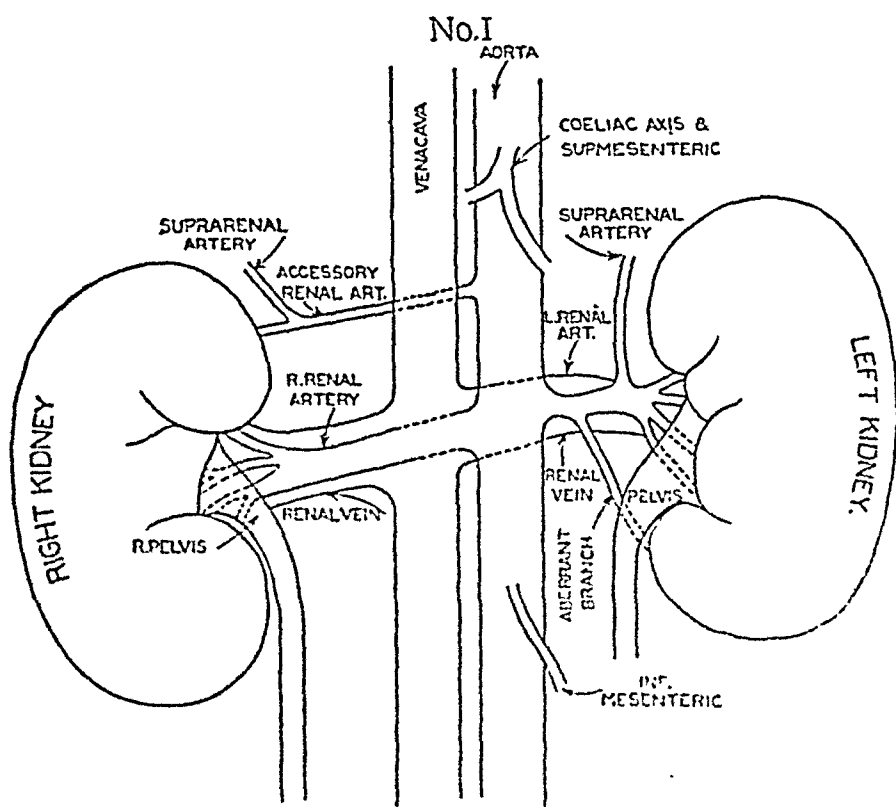
CASE I.—Adult female, dead of tertiary syphilis. Kidneys and genitals otherwise normal, arterial system also essentially normal except that the superior mesenteric comes off the celiac axis. The suprarenal receives a superior branch from the inferior phrenic, no middle branch, and an inferior branch from the accessory renal on the right side and from the renal on the left side. As shown in the drawing, the variation represents two types. On the right side, a truly supernumerary branch comes off the aorta about 4 cm. above the renal, passes behind the vena cava, and enters directly into kidney substance at the upper pole. On the left side, the single renal artery gives off a branch close to the aorta which is about 6 mm. in diameter. This passes behind the ureter to the lower pole of the kidney, where it branches inside of the capsule.

CASE II.—Adult male, dead of tuberculosis. No other essential abnormalities. On the right side the arterial supply to the kidney is normal, but there are three distinct renal veins, all entering the hilum behind the pelvis. On the left side two arteries of equal size come off the aorta at the site of the renal. One gives off the inferior suprarenal and itself passes

¹ Since the preparation of this article a report has appeared in the *Journal of the American Medical Association*, by Drs. Eisendrath and Strauss, in which they give statistics on this subject from the Chicago dissecting rooms. These agree closely with those given by Quain and generally recognized by anatomists.

to the hilum, where it sends one branch behind the pelvis and two in front of it. A second branch, just above, crosses the first in front of the pelvis to the lower part of the hilum. A third branch is given off the aorta opposite the lower pole of the kidney, which it enters after passing in front of the ureter. These branches are of about equal size, fully that of the renal.

An examination of the endings of these anomalous branches indicates that they carry an important blood supply. In each instance the vessel gives off a considerable tuft of

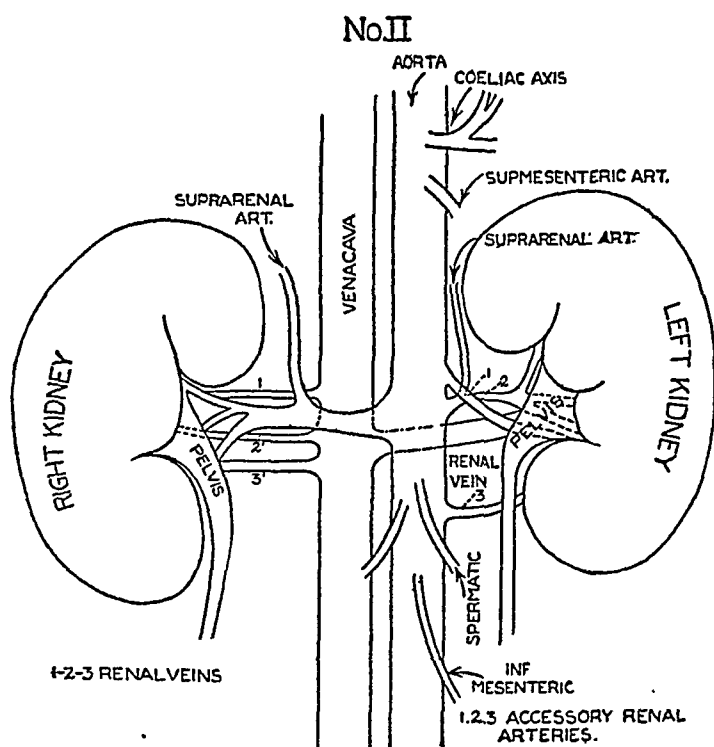


Anomalous renal arteries described in Case I.

branches inside the capsule. Injection material, ultramarine blue and shellac in methyl alcohol, was always found in these branches and in the neighboring tissue. I was unable to determine the relationship of these branches to the main supply at the hilum, and the literature at my disposal gives no additional light on the subject.

Our anatomical concepts are usually formed on the authority of some one or other of the standard texts. Such

pictures we are prone to apply to any and all subjects as constant structures. Even a limited experience in the dissecting room is sufficient to convince one that the standard type is often modified in important particulars. A study of the more common variations is nearly as important as that of the general type. Most of the better anatomical texts give ample descriptions and explanations of the more frequent abnormalities. The works on operative surgery, however, give little or no space to some of them at least.



Anomalous renal vessels described in Case II.

The accepted picture of the blood supply to the kidney is that of a paired renal artery, one to each kidney. Each artery divides, close to the kidney, into three or more branches, some passing in front of the pelvis and some behind. The pedicle consists of a single artery, vein, and ureter. Besides we may also think of several small arteries entering the capsule from the parietal branches. Variations of greater or less importance are described by anatomists as being present in

about 20 per cent. of all subjects. These may be considered under one of three types: 1. The renal artery, instead of being a single vessel from the aorta to the hilum may give one or more branches near the aorta. Such a branch may enter the hilum with the main blood supply or may enter at either pole of the kidney, and may pass either behind or in front of the ureter. 2. There may occur one or more true supernumerary renal arteries from the aorta, either above or below the main branch. This extra vessel also may enter the hilum or either pole of the kidney and may pass in front of or behind the ureter. Such a vessel is more common on the left side and above the main renal. According to Quain they are found in more than 3 per cent. of all cases and rarely four or more such branches occur. Accessory renal arteries of considerable size may come off from the parietal branches, inferior phrenic, or lumbar arteries, or from the spermatic or suprarenal vessels. These branches most frequently enter directly into kidney substance through the capsule. 3. When the kidneys are abnormal in position or shape, as horse-shoe kidney, etc., an abnormal blood supply is commonly found. The main arterial supply may come off the aorta as a single or multiple branch, above or near the bifurcation, from the inferior mesenteric, common or external iliac, or more often from the internal iliac artery.

Anatomically such variations are well recognized by such authors as Poirier, Sharpy, and Cuneo, Quain, Piersol, Gerrish, Sabotta-McMurrich, Treves, Deaver, and others. Practically they are of importance in two respects: first, as cause of unexpected hemorrhage complicating operations on the kidney; second, as a possible factor in the development of hydronephrosis, by causing pressure on the pelvis or ureter.

The frequency of such aberrant and abnormal vessels should be constantly in mind when operating on the kidney or ureter, and would seem to demand considerable attention in works devoted to operative surgery. Whenever the kidney is found abnormal in position or shape, aberrant and

accessory branches should be expected, either at the hilum or entering the capsule. With a normal kidney such vessels are more dangerous because usually unexpected. They may be obscured by adhesions and thus injured without knowledge of their presence, or may be missed in clamping or ligating the pedicle, thus being a possible source of serious hemorrhage. Accessory and abnormal renal veins are even more common than such arteries and are an occasional source of venous hemorrhage. Works on operative surgery give scant or no attention to such possibilities in describing operations on the kidney. White and Martin, Keyes, DaCosta, Fowler, Binnie, Bickham, "International Text-book," and Keen make no mention of the possibility. Bryant speaks of irregularity in the blood supply and gives an illustration showing an accessory renal artery entering the hilum. Jacobson and Steward, speaking of causes of death after nephrectomy, mention hemorrhage, where the pedicle is short and difficult to control or where there are aberrant renal vessels.

The relation of such aberrant vessels to dilation of the pelvis and ureter is a disputed one. Mayo² reports that in twenty-seven cases of hydronephrosis anomalous renal vessels were present in twenty, and an obstruction was found in the ureter at the site of its relation to the vessel. In thirteen of these cases simple division of the vessel in question was sufficient to relieve the condition. Seventy-five per cent. of these vessels passed in front of the ureter. Dr. McCarthy in the same journal gives some interesting drawings which show the relation of the abnormal artery and the dilated pelvis. Gardner³ gives an exhaustive discussion of the subject of hydronephrosis, and considers the relationship of abnormal vessels in great detail. He cites three mechanisms by which such vessels may be presumed to cause hydronephrosis by compression of the pelvis or ureter: 1, intermittent pulsation of the artery; 2, continuous pressure by the vessel; 3, actual kinking of the ureter on such a vascular cord.

² Journal A. M. A., May 1, 1909.

³ ANNALS OF SURGERY, October, 1908.

Dr. Gardner believes, however, that in many of the cases of hydronephrosis the aberrant vessel is not the primary cause of the condition. The drawings in both articles show a close relation between the vessel and the dilated ureter and pelvis. But they do not prove that the vessel caused pressure on a normal ureter, forming a stricture and dilatation. In fact, it is hard to see how such a vessel could affect a normal ureter or pelvis of a normal kidney in its usual position. Some go so far as to state that it is only because of the hydronephrosis that the vessel comes in relation with the ureter at all. There are, however, numerous cases of hydronephrosis where the aberrant vessel is the only apparent cause, and the relation must be recognized as one possibly of importance. One of three associated factors might be involved and with such a vessel lead to further changes in the pelvis or ureter. First, if there was a dilatation from any cause, such a vessel coming in relation to the dilated ureter might cause an angulation or stricture and represent the beginning of a hydronephrosis as shown in some of the drawings. Second, inflammatory adhesions about the pelvis or ureter might be a factor with an aberrant vessel in causing dilatation of the ureter above a stricture. Third, mobility of the kidney may become an important factor. In a simple nephroptosis the ureter might form a kink over an aberrant vessel passing behind it and a subsequent dilatation develop above such a point. This could hardly happen if the vessel were in front of the ureter unless the kidney were to fall forward over the vessel and rotate on its pedicle.

The embryological explanation is interesting though not absolute. Kollmann, McMurrich, and Piersol describe the mesonephros as a segmented structure receiving a series of arterial branches from the aorta. The permanent kidney develops about outgrowths from the upper end of the ureter in differentiated mesenchyme which gives rise to the glomeruli and vascular part of the kidney, at least. It is probable that this tissue also receives several branches from the aorta in the early stages of development, and that the

single renal artery is the result of fusion and obliteration of the extra branches. On such a basis it is easy to understand that variations as described simply represent an incomplete development, so that supernumerary vessels and high divisions of the renal must be very frequent. The truly aberrant vessels from the inferior mesenteric, spermatic, iliacs, etc., are doubtless explained as adaptation on account of abnormal position of the kidney and are a necessary accompaniment of such a condition.

THE ANATOMY AND TREATMENT OF UNDESCENDED TESTIS; WITH ESPECIAL REFERENCE TO THE BEVAN OPERATION.*

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THE quest of an efficient method of replacing the undescended testis within the scrotum has afforded abundant exercise for the ingenuity of surgeons, especially within the past decade or two. It is a barren year, indeed, when no new operation for undescended testis is published, and the galaxy of methods that we now possess is ample testimony that this field of surgery at least has not been neglected. This extraordinary inventive activity is in itself an indication of dissatisfaction with the methods previously recommended, and my own experience corroborates this entirely. Up to within a few years I tried nearly all methods that appeared to me to be rational, but when I viewed my ultimate results, my feelings never even approached that of satisfaction. Since then, however, my experience with the Bevan operation in eighteen cases has given me results so immeasurably superior, that, from my point of view, a satisfactory operation for undescended testis has at last been attained.

This operation involves so many anatomical and physiological problems, that I shall survey these before reporting to you my clinical experiences.

The cause of the descent of the testis is a matter of academic importance, and I therefore shall refrain from discussing it at length. Moreover, there is even now no unanimity upon the matter. Of far greater importance is a correct knowledge of the anatomy of the imperfectly descended testis.

* Read before the New York Surgical Society, October 12, 1910

ANATOMICAL VARIETIES.

Before I enter into a description of the anatomy of the parts in question, I must digress somewhat, in order to give a clearer definition of the abnormality under discussion. As will be seen, there are a number of varieties, and the anatomy of the parts is modified to a certain degree by the particular anomaly.

I. NON-DESCENT.—Without going at length into embryological details, I would merely recall to you, that the primary genital anlage is placed in close proximity to the kidney, and before reaching its ultimate resting place in the scrotum it must pass along the posterior abdominal parietes and through the inguinal canal and upper parts of the scrotum. The testis may be arrested in any part of its course, and in consequence we may have the following anomalies:

1. *The abdominal non-descended testis.* The testis is arrested proximally to the internal inguinal ring.

2. *The inguinal non-descended testis.* The testis is arrested in the inguinal canal.

3. *The pubic non-descended testis.* The testis is arrested just distally to the external inguinal ring, *i.e.*, in front of the pubis.

4. *The upper scrotal non-descended testis.* The testis is arrested in the upper part of the scrotum.

II. MALDESCENT.—This variety differs from the preceding one in the important fact that the testis is not arrested anywhere in its course. The organ is extruded through the external inguinal ring, just like a normal testis; at this point, however, it fails to take its proper course into the scrotum and is deflected into other directions. When this occurs we may have the following three types of maldescent:

1. *The inguinoperforal maldescent testis.* The testis, after its extrusion from the external inguinal ring, is deflected upwards and outwards, so as to lie upon the aponeurosis of the external oblique, between it and the deep layer of the

superficial fascia. I have operated upon quite a number of this variety.

2. *The crural or cruuroscrotal maldescended testis.* The testis lies in the upper part of Scarpa's triangle, or more frequently in the angle formed by the thigh and scrotum. Of this variety I have operated one case.

3. *The perineal maldescended testis,* in which the testis, after its extrusion from the inguinal canal, migrates into the perineum. I have seen two instances of this variety.

SURGICAL ANATOMY.

I have operated upon a considerable number of cases during the past twelve years, have made careful observations and notes in all, and shall endeavor to briefly place these before you. They have, I believe, a definite value, because they are not speculative; on the contrary, they are actual findings which bear very readily corroboration.

1. *The body of the testis* is usually small, at most from one-third to one-half as large as its corresponding fellow, or as large as it should be for the age of the affected individual. In consistency the organ is distinctly softer than normal, but it retains absolutely the so-called "testicular feeling." This feeling is very important in the diagnosis of the position of the testis, particularly when the anomaly is accompanied by a large omental hernia. In a great majority of the cases the testis has a distinct mesentery, allowing considerable mobility, particularly in a lateral direction.

2. *The epididymis* is, as a rule, well developed, but is not infrequently separated from the body of the testis.

3. *The vas deferens* is always of ample length. I cannot lay too great emphasis upon this point, because it has an important bearing upon the operative procedure. In fact, in many instances, the vas deferens is of unusual length and is found extending to the bottom of the scrotum, in the form of a loop, although the testis and epididymis may be situated within the inguinal canal or even within the abdomen.

In regard to this point, I would take emphatic exception to

a recent statement of Katzenstein,¹ that the failures of most operations for cryptorchismus are due to the fact that the very elastic and short vas deferens retracts the testis, after it has been anchored in the scrotum. He attempts to prove his theory by attaching weights to equal lengths of spermatic vessels and vas deferens, isolated from a spermatic cord. No one doubts that this experiment will prove the well-known greater elasticity and resistance of the vas; but it would be utterly fallacious to deduct from this experiment, either that the vas is too short or that it is the cause of failures after operation.

4. *The processus vaginalis* is, as a rule, in open communication with the general peritoneal cavity, thereby converting the sac into a precursor of a so-called "congenital" hernia. I ought to make this statement with some hesitation, because a colleague has told me of a case in which there was an undescended testis, with a perfect tunica vaginalis and no accompanying hernia. Personally I have, however, never seen such a condition.

The nearest approach to such a condition came under my observation recently. The testis was high up in the inguinal canal and was accompanied by a large hernia of the congenital type. There was another sac in the scrotum, which contained a moderate amount of clear serum; the upper sac was invaginated into the lower one. In other words, the hernia corresponded more to what is termed the "infantile" type.

In approximately one-half of the cases, particularly in those accompanied by large herniæ, the vaginal process extends to the bottom of the scrotum. I wish to lay emphasis upon the point, that in about one-half the cases the vaginal process does not extend to the bottom of the scrotum, because it indicates a divergence between the observations of the embryologist and of the surgeon. The embryologist claims that the testis is always preceded in its descent by an outgrowth or prolongation of the peritoneum into the scrotum. Were this the case, we should have no trouble in demonstrating this pro-

¹ Zentralblatt f. Chirurgie. No. 31, 1910.

longation in every case of undescended testis. As a matter of fact, we do not find it; at all events, I have never found it except in cases that are accompanied by a scrotal hernia of considerable dimensions. I believe that in these cases the prolongation was pushed to the bottom of the scrotum by the advancing hernia and was not a pre-existing entity.

Much stress has been laid by some surgeons upon the vaginal process as an obstacle to the bringing down of the testis at operation. I believe this theory is erroneous for the following reasons: (1) It does not take into consideration the different lengths of the sac. (2) The testis is in reality a retroperitoneal organ, and its motility cannot, therefore, be affected by something outside of it. (3) Even when the neck of the sac is freed and ligated, the testis is no nearer to the bottom of the scrotum than before. (4) The most practical of all, I have never found the sac to give me the slightest difficulty in mobilizing the testis.

The peritoneum forming the vaginal process, even when accompanied by old and large hernia, is exceedingly thin and delicate, requiring extremely careful and cautious dissection in order to liberate it.

5. *The spermatic cord* is not gathered into a normal cord-like structure, but is spread out fanshape over a considerable area. The vas, as a rule, lies somewhat isolated from the other component parts of the cord. The spreading out of the structures and the already mentioned thinness of the serous membrane make the dissection and freeing of the sac a step of unusual delicacy.

6. *The spermatic vessels* are poorly developed. Both the veins and the spermatic artery possess a smaller calibre than normal. When the spermatic artery is cut, the bleeding is slight, or at all events not nearly as free as in a normal case. I am also of the opinion that the small size and softness of the testis is due to this hypoplasia.

I now come to one of the most important observations in regard to the surgical anatomy of non-descended testis. It is this: *the spermatic vessels are deficient in length*, and appar-

ently by the distance between the testis and the bottom of the scrotum. Whether this shortness is due to a congenital hypoplasia, I am not prepared to say. It would also carry me into the realms of speculation were I to decide off hand the question, whether the non-descent of the testis is due to the shortness of the vessels or whether the shortness of the vessels is caused by the non-descent of the testis. Arguing by analogy, similar anomalies have been noted in malpositions of other organs, *e.g.*, malpositions of the kidney; and while I have no absolute proof, I am inclined, for want of a better theory, to assume that the non-descent is in a great measure due to the shortness of the spermatic vessels.

It is also needless to add that at this time I speak only of the undescended testis, for in the maldescended organ the blood-vessels are of sufficient size and length.

7. *The scrotum* varies in size; this variation, I have found, depends upon the presence or absence of a hernia. If no hernia is present, the scrotum is very small; but if a hernia is present, the scrotum is large, its size varying with the size of the hernia. Some writers lay considerable stress upon the non-development of the scrotum, both as a cause of the non-descent of the testis and as a cause of the inability to anchor the testis properly. I am positively of the belief that both these assumptions are erroneous; first, because the scrotum accommodates itself easily to any size, either by a hernia, or by the replacing of one testis, or by the replacing of even both testes; and second, because the embryological development of the scrotum is independent of that of the testes.

There is not much to say of the anatomy of the maldescended testis. The gross anatomy is like that of the normally descended testis. Exceptions are to be noted mainly in the regional anatomy. Very frequent also is the presence of a congenital hernia. Above all, it is to be recollected that the cord as a whole and integrally is never too short, and after being freed from the surrounding structures, there is never any difficulty in transplanting or retaining the testis in the bottom of the scrotum.

REASONS FOR OPERATING.

1. Every undescended testis is accompanied by a hernia, either actual or potential. Furthermore, in these herniæ, the application of a truss is either impossible or painful. The use of the forked truss has in my hands not proven serviceable.

2. The undescended testis is more subject to trauma than the normally situated testis.

3. It is important to remember that the testis possesses two functions: (a) the elaboration of spermatozoa, (b) the maintenance of sexual characteristics. In undescended testis the burden of belief seems to be that the spermatogenetic function is either totally absent or reduced to a minimum. This has been ably proven by Haines, who showed in a convincing study that in pigs, in whom undescended testes are very common, the spermatogenetic cells are all absent. On the other hand, he showed that the interstitial and Sertoli cells, which he believes bear important relations to the maintenance of sexual characteristics, are preserved and are enormously increased in number. The preservation of the second function is therefore a paramount indication for a conservative operation upon an undescended testis, especially in the young.

4. Although it is claimed by many that the replacement of the testis within the scrotum restores its spermatogenetic function, I have not been able to convince myself of this entirely. In one case, in which I replaced both testes, spermatozoa were absent both before and after operation. However, even the possibility that the spermatogenetic function may be restored is, to my mind, an indication for operation.

5. The not infrequently observed development of malignant tumors in non-descended testes should be considered as an indication for operation. I have seen one instance of this.

6. An undescended testis is peculiarly liable to certain accidents, which may frequently threaten and destroy its life. I refer particularly to torsion of its spermatic cord. I have operated upon three cases of this nature, in two of which I was compelled to ablate the testis at the primary operation; in

the third case I made an attempt to untwist the cord and preserve the testis, but was unsuccessful and had to ablate it at a second operation. De Quervain describes a peculiar accident in an undescended testis, by which either the body of the testis or its cord becomes strangulated by the pillars of the external ring. I have never seen a case of this nature.

7. Extension of a gonorrhœa to a scrotal testis or metastatic involvement in mumps is sufficiently distressing, but these conditions in an undescended testis are very grave and may even menace the patient's life.

8. A minor reason, perhaps, and yet not a negligible one, is the psychic depression under which adults suffer when only one, or worse still, when neither testis is in the scrotum.

There is no contraindication, except perhaps extreme youth. This, however, merely implies a postponement of the operation to a suitable age. Personally I have decided upon the age of three as the lowest limit, and postpone operation in all younger cases, unless forced to operation by strangulation or other accidents.

TREATMENT.

First of all, I wish to emphasize that I do not regard a case of undescended testis as cured unless the testis is at the lowest part of the scrotum. I have had shown to me cases of so-called "cure" of an undescended testis, in whom the testicle was sometimes even as high as the upper third of the scrotum or front of the pubis. To call such cases "cures" is, to my mind, an evidence of a deplorable sense of satisfaction.

In view of the fact that I successively tried nearly all methods of treatment that have been recommended, a short résumé of my experiences may perhaps prove of some value. I shall try to demonstrate why these methods have largely been failures in my hands, and why I have finally settled upon the Bevan operation as the most satisfactory of all.

1. One of the first methods of treatment for undescended testis was that advocated by Langenbeck. This consisted in massage, manipulations, and the application of a forked truss,

to prevent the testis from slipping back. I have tried this method faithfully in a number of cases, where for justifiable reasons I could not operate, but with the exception that the testicle may in favorable cases be retained outside of the inguinal canal, I have seen no benefits from this method. The truss causes much discomfort and retains the hernia but unsatisfactorily.

2. The objections to orchidectomy are so apparent that I shall not even mention them. I may add, that in former years I also was guilty of performing this operation.

3. Replacement of the testis within the abdomen, with closure of the internal inguinal ring, has been suggested and carried out. With the exception of the fact that it cures the hernia, I can see no advantage in this operation over non-interference, inasmuch as it exposes the testis to all the other dangers inherent to the non-descended organ, and is certainly not cosmetic.

4. On the theory that the non-descent of the testis was due to a shortness of the vas deferens, I attempted in one case to lengthen the vas by unravelling it from the epididymis. I have not looked up the literature upon this point and do not know whether anybody has tried it before or after me. The result was a complete failure. The theory, I have since learned, was based on a misconception, and I am now convinced, as I have said before, that the vas is always of ample length.

5. Schüller's operation.² Early in the study of the pathology of undescended testis, the presence of the open tunica vaginalis was regarded as the cause of the non-descent. The destruction of this peritoneal prolongation was therefore considered as imperative. As advised by Schüller, this was done by dividing the tunica at the internal inguinal ring, forming a new tunica vaginalis from the lower part, and anchoring the testis to the scrotum by sutures. This operation has in my hand succeeded in a small number of cases, but only in those in which the testis is already very close to the scrotum; in

² *Zentralblatt für Chirurgie*, 1881.

other words, in milder forms of the affection. In more aggravated cases, however, when even the slightest tension upon the cord becomes necessary, either one of two things happens: the testis tears loose from its anchorage in the scrotum and retracts to its original position; or if the anchorage holds, the scrotum gives way and is invaginated and pulled up by the retracting testis. In order to obviate this, the method has undergone numerous modifications.

(a) The fascial structures of the cord were sutured to the pillars of the external inguinal ring (Dowd, Kocher).

(b) The septum scroti was incised, and the undescended testis sutured to its fellow of the opposite side.

(c) The testis was anchored to the bottom of the scrotum by sutures passed through the latter, and tied over an external pledget of gauze.

(d) Lanz's operation.³ Sutures were passed through the testis; these sutures were then passed through the scrotum, left long, and fastened to a wire cage or to thigh, or, according to some, even to the big toe; the idea being that the continuous traction will so lengthen the cord that upon removal of the sutures the testis will stay in the scrotum. Ingenious as this idea appears, I have seen two recurrences after this operation.

(e) A small incision is made in the bottom of the scrotum, through which the testis is extruded; the incision is closed snugly, leaving the testis outside, the idea being to leave it there until adhesions have formed, whereupon the incision is reopened and the testis replaced. The objections to this method are, (1) the dangers of infection, and (2) the uncertainty of the result.

(f) Starr⁴ fastens the testis to a wire splint, which is fixed on one end to the pubic bone and at the other to the scrotum.

(g) Keetley-Torek. This operation is divided into many steps, consisting in a great measure of very delicate manipulations and complicated sutures. I shall not describe the operation in detail, but in essence it consists of the following steps:

³ Zentralblatt für Chirurgie, 1905.

⁴ ANNALS OF SURGERY, vol. xlviii.

The testis is liberated and the hernia corrected. An incision is then made in the bottom of the scrotum, through which the testis is extruded. At a properly selected place an incision is then made upon the thigh, down to the fascia; the testis is fastened to this structure, and the two lips of the scrotal incision are sutured to the two lips of the thigh incision. The principle of the operation consists in the belief that the fixation of the testis to the thigh lengthens the cord. At a second operation, from three months to a year later, the scrotum and testis are liberated from the thigh, and the testis replaced within the scrotum.

Excluding the technical difficulties, which, to my mind, are minimized by the originators of the operation, the operation possesses a number of objections. The postoperative course is not a very pleasant one for the patients; they object to the continuous dragging upon the testis; and after the wounds have healed, their gait is worse than awkward; they are troubled for a long time with a disagreeable eczema from the apposed skin surfaces, particularly in hot weather. The danger of infection is not small, and, finally, the necessity of performing two operations is not to be considered too lightly.

For the sake of completeness, I may add:

6. Beck's necktie operation,⁵ which at best can only hold the testis outside of the external inguinal ring.

7. Kirschner's operation⁶ was published this year, and only goes to prove that the possibilities are by no means exhausted. A sort of bell-shaped receptacle is made for the testicle, from a piece of the fascia lata of the patient (autoplastic), which is passed through a subcutaneous tunnel and is fastened to the superficial perineal fascia.

8. Bevan's operation.⁷ When I read Bevan's original report, I was at first inclined to be sceptical, believing that the division of such important parts of the spermatic cord must surely result in gangrene of the testis. Bevan's report, how-

⁵ N. Y. Medical Record, Aug. 12, 1905.

⁶ Langenbeck's Archiv., vol. xcii, p. 925.

⁷ Langenbeck's Archiv., vol. lxxii, p. 1035.

ever, was so reassuring, that I determined to try the operation. Since then I have never had occasion to regret my decision.

Before explaining to you the principles upon which the operation is based, I shall describe the operation in detail.

1. The cutaneous incision is like that for the radical cure of inguinal hernia. The aponeurosis of the external oblique is split in the direction of its fibres. Retraction of the lower flap exposes Poupart's ligament.

2. The hernial sac is now isolated and freed from the spermatic cord. It is advisable to begin the isolation of the sac at the neck; when this is done, the peritoneal cavity is closed, either by transfixion and ligation, or by circular suture. It is perhaps needless to add, that when the testis is intra-abdominal, it is essential to first open the sac and extract the testicle from the abdomen. I have never seen the occasionally described adhesions between the testis and the peritoneum, due, as some authors claim, to a fetal peritonitis, which in turn was supposed to cause the non-descent of the organ.

The distal part of the sac can be dealt with in three different ways: (*a*) it may be cut off close to its attachment to the testis; (*b*) it may be cut off at some distance from the testis, and a new tunica vaginalis formed; (*c*) it may be everted and sutured. I have used all three methods, and have obtained equally good results with all. I prefer the first method, because it saves time by not requiring any sutures.

In isolating the sac there is one very important point to be observed. The liberation of the vas deferens from the sac must be carried out with exceeding care. The vas deferens should never be handled roughly, and should certainly never be pinched with forceps. The ultimate viability of the testis depends, as will be shown later, upon the small artery of the vas, a branch of one of the vesicals, and if this should be injured or thrombosed there is a grave danger of necrosis of the testicle.

3. If the parts are now examined, there will be seen the vas deferens with its vessels, and the spermatic vessels, diverging as they enter the internal inguinal ring; the former going

downwards and inwards toward the bladder, the latter almost directly upwards and slightly inward.

The cord is now gauged as to whether or not it will permit transplantation. In minor degrees of non-descent, transplantation may be possible. If it is impossible to bring down the testis, traction upon the cord will readily show that the spermatic vessels become taut, and not the vas deferens.

In some instances freeing the vessels of all extrinsic fascial structures, by teasing and occasional snips with the scissors, will enable the testicle to be brought down. In most cases this will not suffice, and we have to proceed to the essential part of the Bevan operation, namely, the division and ligation of the spermatic vessels.

The moment this is done, it will be seen that no matter how high up the testis may have been situated, there is not the slightest difficulty in bringing the testis down to the very bottom of the scrotum, particularly if the vas is freed down to the epididymis.

4. The corresponding half of the scrotum is now stretched with the finger or dressing forceps, for the accommodation of the testis. There is never any trouble with this step, no matter how small and how shrunken the scrotum appears to be. Into the pocket thus formed the testicle is placed without any anchorage, and in order to prevent any possible luxation, the neck of the scrotum is closed around the vas by an interrupted or circular suture.

5. The radical operation for the hernia is now proceeded with, without any transplantation of the vas. In some instances I have adopted the Fowler operation, which diminishes the arc of the spermatic cord. In one instance I tried to gain space by liberating the deep epigastric vessels and slipping the testis behind the vessels, before transplanting the organ into the scrotum. I have found this, however, to be an unnecessary and bothersome refinement.

POSTOPERATIVE COURSE.

Not infrequently, on the second or third day after operation, there is more or less exudation around the testis. Whether

this is due to an infarction, or thrombosis, or to a diminished return flow, I am not able to say definitely, for the simple reason that I have never had occasion to reopen the wound. Under the application of a hot water bag, this exudation, however, quickly becomes absorbed. In my earlier cases I rather dreaded this œdema and feared interference with the blood supply, but I have now become accustomed to it.

RATIONALE OF BEVAN'S OPERATION.

Bevan devised his operation upon a correct knowledge of the blood supply of the testis, and upon the important discovery, as I have already emphasized, that the inability to bring the testis down into the scrotum was due to the shortness of the vessels of the cord.

For a long time it was assumed (Miflet⁸) that the spermatic artery is an end artery, and that it is the sole arterial supply of the testis. Recent investigations (Griffiths⁹ and Hill¹⁰) have, however, shown that this is an error, and that the testis has an additional and very important blood supply, namely, the artery of the vas deferens, a branch usually of one of the vesical arteries.

In order to prove this to my own satisfaction, from a physiological view-point, I performed a series of experiments on dogs at the Pathological Laboratory of the College of Physicians and Surgeons, through the kindness of Professor MacCallum. I divided the spermatic vessels, leaving the testicle *in situ*, and removed the testes at periods varying from four days to three weeks after operation. The testes were examined histologically. In no instance did gangrene occur. Microscopically, some of the testes, especially the earlier ones, showed some necrosis in the interior of the testis, but around the periphery the alveoli presented a fair state of preservation. Upon second thought, I have come to the belief that I removed the testes too soon after operation, not permitting sufficient time for regeneration. While my experiments are therefore not

⁸ Langenbeck's Archiv., vol. xxiv.

⁹ Journal of Anatomy and Physiology, vol. xxx, p. 81.

¹⁰ American Journal of Anatomy, 1909, p. 463.

entirely convincing in affording a proof of perfect preservation of the testicular tissue after ligation of the spermatic vessels, they do prove the important point, namely, that the testis does not become gangrenous. When we consider that undescended testes, as shown by Haines, are in all probability non-spermatogenic, the problem after all, whether the alveoli of the testis are destroyed or not, is a matter of small consideration.

If further proof were wanting, the results of the Bevan operation speak for themselves. In no case of my series did necrosis of the testicle occur, and the preservation of erectile power is, to a certain extent, proven by the maintenance of perfect *potentia cœundi* in one adult case of bilateral undescended testes which I operated.

RESULTS.

I have operated on eighteen patients by the Bevan method. Fourteen were operated at Mount Sinai Hospital, and four at the Har Moriah Hospital. Inasmuch as four were bilateral, I have performed the operation twenty-two times. The first case was operated upon July 26, 1905, the last case in August, 1910. I have kept most of these cases under continuous observation, and I may add that with the exception of my second case, in which the testis is even more atrophic than at the time of the operation, the final result is more than satisfactory. Primary union resulted in every instance; there is no recurrence of the hernia; the testis is freely movable and in the very bottom of the scrotum. In other words, all these patients can be legitimately regarded as completely cured, as far as the descent of the testis and the hernia is concerned. I do not believe that any other operation for undescended testis can establish a record comparable to this.

The purpose of this paper is therefore an advocacy of the Bevan operation. I do this not only from a sense of pleasure over the results that it has afforded me, but also because the operation, if the infrequency with which the operation has found its way into the literature is a criterion, has thus far found few adherents.

RESECTION OF THE MALE RECTUM FOR CANCER, BY THE COMBINED METHOD IN TWO STAGES.*

FIRST STAGE UNDER SPINAL ANÆSTHESIA.

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A MAN, age twenty-seven years, machinist by trade, had mucous discharges from the bowel for six months prior to operation, with passage of blood only two or three times. He had lost about twenty-seven pounds in weight. In the anterior wall of the rectum, was a tumor whose lower limit was between one and a half and two inches above the upper margin of the internal sphincter, while above, it reached to the anterior valve of Houston. It measured transversely from about one and a half to two inches. A microscopic diagnosis of adenocarcinoma was made.

Wishing particularly in the case of this very young man to preserve the normal bowel control which would enable him to continue unhandicapped a life of usefulness, it was concluded to perform, if possible, resection of the rectum. To determine whether or not resection could be accomplished, it was quite essential that the abdomen be first opened, to ascertain, first, whether the tumor was adherent to the base of the bladder, and second, whether the sigmoid flexure above the disease was capable of sufficient descent to re-establish the continuity of the bowel.

Perhaps the greatest objection to attempting resection of the rectum is the prolonged anæsthesia needed for its accomplishment. It was reasoned that if spinal anæsthesia could be utilized for the abdominal portion of the operation, then the rest of the operation through the posterior route could be done under ether at a second sitting on the following day, and the period of ether anæsthesia thus considerably shortened.

* Case presented before the New York Surgical Society, Oct. 12, 1910.

The administration of spinal anæsthesia in a way to secure analgesia of the abdomen has been scientifically worked out by Barker,¹ who employs therefor a particular posture of the patient and as anæsthetic a stovaine-glucose solution having a specific gravity much heavier than that of the spinal fluid. The patient is placed in Barker's position by laying him on his side on a flat table with his hips elevated on a block one inch thick, and his head and neck raised as nearly vertical as possible. This posture throws the spinal column and cord into a position of lateral curvature, the most dependent point of which is about the mid-dorsal region, to which level the specifically heavy stovaine-glucose solution gravitates when injected at the midlumbar region, and exercises there its paralyzing effect on all of the cord below. The head and neck are elevated so as to keep the locality of the foramen magnum beyond the reach of the specifically heavy stovaine solution. The elevation should be maintained for a time following the operation. When the patient is turned on the back the locality of the dependent point in the spinal curve is not materially altered. If the patient remains on his side, analgesia is confined to the side on which he is lying. In manœuvring to secure as much Trendelenburg position as possible for use in this case without too much lowering of the head, it was found that by raising the foot of the table so as to incline the latter about 4 degrees, and then placing the hips on a sand pillow about one and a half inches in thickness, the head and neck being at the same time propped almost upright, the foramen magnum still lay well above the level of the dorsal dip. This posture was therefore employed both for the lateral position during the administration of the injection, and afterward for the dorsal position as well, to which latter, in order to allow the pelvis to tilt forward, there was added the support of the thighs in the flexed position by sand bags and pillows beneath the knees. It was found at operation that this dorsal posture fulfilled all the requirements of the Trendelenburg position. It can be seen that spinal anæsthesia for the second stage of this operation, at least with the use of a specifically heavy anæsthetizing solution, would be contraindicated, on

account of the necessity in it of lowering the patient's head while anastomosing the bowel ends.

The patient was prepared for operation by the administration of castor oil on the preceding third and second nights, followed on the day and night immediately before operation by enemata, which were repeated until the abdominal wall was a little retracted, and the administration of deodorized tincture of opium.

Except for the two-stage feature, the operative procedure in this case of resection of the rectum was quite similar to that in another case already illustrated by the writer.²

First Stage, June 24, 1910.—Spinal anæsthesia was administered in the lateral posture, and right afterward the patient was placed in the dorsal posture, as above described. The puncture was made between the second and third lumbar vertebræ, about 10 c.c. of spinal fluid were removed as a preventative against vomiting and headache, and then 0.06 gramme of stovaine* was injected. Complete analgesia up to a level about two inches above the umbilicus was quickly produced and lasted just 50 minutes. The abdominal wall was perfectly relaxed. The analgesia terminated abruptly, and the pain for the remainder of the operative procedure was deadened with a surprisingly small amount of chloroform. The abdominal operation lasted 1¼ hours. It took a few minutes longer to effect the posterior drainage opening. The operative steps were as follows: Median abdominal incision. The prerectal space was first opened up presenting a normal cleavage between rectum and bladder, thus establishing at once operability. The sigmoid flexure was estimated to be capable of sufficient descent to permit of resection, there seeming to be a sufficiently long sigmoid loop with a mesosigmoid of a proper anatomical formation to permit the piece of bowel above the disease, after being freed by division of the mesosigmoid proximal to the arterial arcades, to be brought about six inches below the left common iliac artery. The rectum was then freed behind, the internal iliac and superior hemorrhoidal arteries were isolated and tied, the lateral neuro-fibrous attachments of the rectum to the pelvic wall (pelvirectal attachments) were isolated and cut, thus mobilizing the remaining

* The anæsthetic solution here used was made according to Barker's early formula, which was stovaine, 10 per cent., and glucose, 5 per cent. Later Barker used a solution containing stovaine, 5 per cent., and glucose, 5 per cent.

paraproctæal attachments so that in the second stage they could be hooked downward with the finger through the posterior wound and severed widely, and both peritoneal leaves of the meso-sigmoid were cut, and two sigmoid arteries isolated and tied proximal to the arterial arcades. The left peritoneal attachment of the sigmoid was cut high in the iliac fossa and the corresponding piece of bowel stripped out of its bed to allow a maximum descent of the freed segment. The posterior lymphatics of the rectum were infiltrated up to the site of entrance into the bowel of the superior hemorrhoidal vessels. The peritoneal opening was narrowed by drawing together its edges at the upper portion of the pelvic cavity with three stitches, behind the liberated bowel. A 20-inch-long rectal tube was inserted into the bowel for the escape of wind. It did not reach quite through the entire length of the freed loop. The tube was rather stiff, and soon after finishing the operation, fearing that it might cause undue pressure on the bowel up in the iliac fossa, it was drawn down about eight inches. The deep abdominal wound was supported by three kangaroo stitches in anticipation of the ether anæsthesia to be administered on the following day. A drainage opening was finally made alongside the coccyx into the retrorectal space.

Immediate Result.—There was not a particle of shock. There was no nausea, headache, or abdominal distention. The patient began to drink water three hours after the completion of the operation, and was able to take it freely. He also took during the afternoon and evening twelve ounces of milk. He passed a comfortable night. The next morning just before operation the rectum was washed with a borax solution which removed considerable mucus, and the tube introduced on the previous day was withdrawn. The patient was given Magendie minims vii and atropin grain $\frac{1}{50}$ an hour preceding operation.

Second Stage, June 25, 1910.—Patient anæsthetized in the position for beginning the operation, which was on his left side with thighs and knees semiflexed, starting with chloroform so that there should be as little straining as possible, and then changing to ether. There was in this way no struggling. The sphincters were then stretched, and with a gauze wipe the rectum was determined to be practically dry. An inch wide strip of gauze soaked in a chinosol solution 1 in 500, was introduced into the lower rectum and anus for their disinfection, until

the time for opening the bowel should arrive. The posterior approach devised by myself⁸ was utilized. This consists of a central incision which diverges at the coccyx from the median line to pass through one ischiorectal fossa, avoiding the inferior hemorrhoidal nerves, with two wide lateral cuts, the reflection of the coccyx in one of the lateral flaps, and the removal of the portion of the sacrum below the inferior lateral angles. In making the posterior incision there was free bleeding from but three or four small points in the soft parts. There was some hemorrhage in dividing the sacrum, which soon became self-arrested. There seemed to be no median sacral artery. The lateral paraproctæal attachments of the rectum were easily hooked down over the finger and severed. A middle hemorrhoidal artery lay in these structures on the right side, which on division spurted freely, this notwithstanding the preliminary ligature of the internal iliacs. The left middle hemorrhoidal artery was dissected out and tied before severance. The bowel was freed down to the upper level of the internal sphincter. A narrow iodoform strip was now passed up along either side of the bowel into the peritoneal cavity, and one anteriorly, and a temporary gauze pack was made to occupy the wound cavity to protect against infection during division of the bowel. The bowel was clamped across an inch below the tumor just above the internal sphincter, and severed close to the clamp. The severance was made according to the technic of Kraske, by interrupted cuttings and the placing of traction loops of heavy silk at intervals along the margin of the distal segment as it became freed, for the subsequent control of the edge in suturing. The patient was now put in Kraske's dorsal position, with high elevation of the hips and thighs flexed over the abdomen, for suture of the bowel ends. The bowel was sectioned above the tumor opposite the site of entrance of the superior hemorrhoidal vessels, which was just beyond the indurated posterior lymphatics. A higher division of the bowel would not have left enough to re-establish the continuity of the gut. In dividing across the mesenteric border of the descended gut, there was a marginal artery which spurted freely. The portions of the peritoneal leaves of the mesosigmoid which remained attached to the freed proximal end of bowel, causing the latter to curl a little on itself, were cut where they exercised restraint to the straightening out of the gut.

The bowel ends were sutured together for most of the circuit, with interrupted sutures of stout iron-dyed twisted silk tied on the inside, and a few chromic sutures placed externally effected the final closure. Celloidin linen thread for the inner stitches would probably be preferable to silk. A stout full-curved round needle was used. Care was taken to include serous surfaces of the proximal segment within the grasp of each stitch. The mesenteric attachment of the proximal segment lay in the posterior median line of the anastomosis, at which site serous surfaces were brought into the line of union by a Maunsell mesenteric stitch. For the avoidance of stricture, care was taken to make an even coaptation of the mucous edges, the latter being first caught with sutures (which included the edge of the serous coat of the proximal segment) at intervals at opposite points, and then by traction on any two of these adjoining stitches the mucous edges would be held evenly in apposition while deeply placed stitches, including about half an inch of either margin, were passed and tied. When the anastomosis was completed, the temporary gauze packing was removed, and a gauze strip soaked in glycerin was placed gently upward along either side of the bowel and in front of the lower portion of the sacrum. There was no drain placed near the suture line. In fact the levatores ani were drawn together directly over the posterior portion of the suture line in the hope of getting an early adhesion here with serous surface that would fortify the union. The lateral muscular cuts were each approximated with two or three chromic sutures. A small double-barrelled tube drain was inserted through the anus.

Result.—Recovery uneventful except for the development of a small fistula on the eighth day, which was one day before the bowels were moved. Highest temperature 101° on the seventh day. Tincture opii deodorat. administered. The patient did not suffer from abdominal distention. He expelled wind freely through the tube in the anus. On the fourth day the glycerin gauze drains were removed, on the sixth day the two lateral iodoform strips were taken out, and on the seventh day the anterior one. The interior of the bowel was syringed every day with a chinosol solution, 1 in 500, and on the fifth day the daily injection of a little olive oil was begun as well. The reflux from these syringings was practically always clear. When

the bowels were moved on the ninth day, all the discharge, which was watery, came through the posterior wound. At the same time the effort to discover the fistulous track into the bowel with a probe was unsuccessful for some days. The opening, which was not large, was located anterolaterally on the right side. The patient had lain chiefly on his left side, toward which the bowel evidently sagged, thus removing the suture line on the right side from a perfect apposition with the surrounding tissues and consequently interfering with the opportunity for a supporting adhesion to form at this portion of the periphery. The leakage may, however, have been due to infection. The lateral cuts healed by primary union, as did also the abdominal wound.

The wound has gradually closed. Since the middle of September there has been no fecal leakage, and during the past ten days (prior to October 12) escape of wind through the fistula has been noticed but twice. (On November 7, the fistula had completely healed.) The sphincters functionate normally, and there is no stricture at the seat of anastomosis. The patient has regained his normal weight. (On November 7, he had gained 36 pounds.)

Dr. Crowell who examined the specimen, reported that the tumor had apparently been excised beyond the limits of the disease. Sections at three levels at the upper part of the indurated posterior lymphatics showed evidence only of an inflammatory process.

Special Considerations.—1. The abdominal portion of the combined operation in resection of the rectum may be done under spinal anæsthesia without any shock.

2. *Lumbar puncture* can be made a very simple procedure if the needle be introduced in a direction forward and very slightly inward just lateral to the interspinous ligament. The skin should be nicked about one-third of an inch from the median line at the site of introduction of the needle. The first deep guide is the ligamentum subflava which offers its resistance to the needle point, and next is the dura beneath it, puncture of which with a needle not too sharply pointed, can usually be felt, or may even be heard. The writer has employed this technic on occasion, always satisfactorily, for

several years, but wishes to acknowledge that a similar technic has recently been published by H. Tyrrell Gray⁴ who, using the same deep guides, directs the point of the needle inward and a little upward toward the posterior median line of the dura. By this method one can be readily guided by the sense of touch, which latter, in a median puncture where the needle must traverse the dense supraspinous and interspinous ligaments, would at least have little delicacy. Gray reports that in 200 cases of lumbar puncture by the method described, he touched a nerve twice with no other ill result than momentary pain, and once in a case of fracture of the base of the skull, with resulting cessation of respiration for a considerable period of time, apparently excited by a definite movement of the needle. The writer uses a platinum needle with an extremity cut diagonally at such an angle as to make a short oval opening and a point that is not too sharp.

3. Barker brings out the fact that stovaine solutions may be boiled at 115° C. for 15 minutes without loss of potency. Another factor in the use of stovaine is, that sodium carbonate or other alkaline fluid neutralizes its action, so the injecting syringe and needle should be boiled in plain water.

4. Since in this case only just enough bowel could be liberated by the abdominal route to reunite the ends after excision of the disease, cutting the attachments upward into the iliac fossa, a resection of the bowel with end-to-end suture could not have been accomplished by the posterior route alone, much less an implantation within the denuded sphincters.

5. Since the preliminary *ligature of the internal iliac arteries* did not control the hemorrhage from the middle hemorrhoidal branches, its chief advantage in the male must be for limiting the hemorrhage in the making of a posterior or perineal approach. *Technic:* The internal iliac arteries can be very easily isolated for ligature by passing the finger beneath the fascia propria recti, locating the bifurcation of the common iliac, which is situated about one inch lateral to the promontory, and stripping with the finger, using some force, from the angle of divergence of the two vascular trunks,

downward and backward along the anterior border of the internal branch. The fascia tears through and the artery raises off from its accompanying vein. This procedure, done by the sense of touch, facilitates very greatly ligature of these vessels. It was practised in this case. For stripping the artery free, it is better to stand on the side of the patient corresponding to the vessel, but in passing the ligature, it is better to stand on the side opposite to the vessel.

6. The surgical importance of the *lateral pelvirectal attachments*⁵ may well be again emphasized. The severance of these unyielding, fascial, nerve-supporting connections between rectum and pelvic wall, extending from just below the level of the ureter to the fourth sacral foramen, is very important in the mobilization of the rectum.

7. The posterior approach here employed gives a broad operative field for performing the anastomosis, affords good drainage, and is easily closed around the drainage opening. It has healed promptly in two cases where it has been used, re-establishing firm support.

8. When, in resecting the rectum by the combined operation, the bowel is divided through the posterior wound after having packed off the peritoneal cavity, and a tight anastomosis made with a complete circular suture, the danger of fecal infection of the peritoneal cavity must be *nil*.

9. If the mucous edges of the bowel ends be evenly coapted, provided union take place, there should be no stricture.

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- ¹Barker: British Medical Journal, 1907, i, p. 665; and *Ibid.*, 1908, i, p. 244.
- ²Lusk: Surgery, Gynæcology and Obstetrics, ix, 1909, p. 491.
- ³Lusk: *Ibid.* and Surgery, Gynæcology, and Obstetrics, vii, 1908, pp. 205-207, 222.
- ⁴Gray: Lancet, 1909, ii, pp. 913, 991.
- ⁵Lusk: Surgery, Gynæcology, and Obstetrics, ix, 1909, p. 501.

FRACTURE OF THE TARSAI SCAPHOID.

WITH A REPORT OF CASES TREATED BY OPERATION.

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AND

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THE treatment of two cases of fracture of the tarsal scaphoid, in the Orthopædic Department of the Carney Hospital within three months of each other, makes timely this report and a review of the literature of previously reported cases. Practically no mention is made in our latest textbooks on fractures of the tarsal scaphoid other than that made by Stimson to the effect that its occurrence is rare, except with other tarsal fractures.

Fracture of the scaphoid is due usually to violence from falls, received either in forced dorsal or plantar flexion. In striking so, the scaphoid transmits the whole force of the violence.

Slight twists occasionally accompanied by a Pott's fracture can result in a fracture of the scaphoid. The local sign is the swelling from disturbance of circulation and trauma, exaggerated when a dislocation of the fragment has taken place. Tenderness over the scaphoid on the inner side depends largely upon the time elapsing after the fracture.

Ankle-joint motions in flexion and extension are normal, but when forced are accompanied by pain referred to the scaphoid. The midtarsal motions are markedly restricted. The foot is held in slight eversion, and practically no inversion is possible. Both the lateral and anteroposterior radio-

grams will show the fracture and displacement. The treatment in these cases is conservative for at least the first few days. If the displaced fragment can be reduced and the foot held in inversion, we may expect a good functional result. If, however, this is impossible, operative treatment should be at once begun. This fracture, located as it is, and so important to the normal arch of the foot, will not permit of any laxity of treatment. The whole static mechanism of the limb is involved and is readily thrown out of plumb by an improperly reduced fragment or malunion. We believe that operative interference resorted to early, not only is safe, but insures better function and less static disturbance.

Operative Treatment.—This consists of (a) cutting down upon the fractured scaphoid and taking out the fractured portion; or (b) making an excision of the scaphoid *in toto*, leaving as much of the periosteum as possible in order that regeneration of bone may take place. This latter procedure is especially satisfactory, as the remaining scaphoid is usually crushed and will develop hyperplastic tissue. The new bone formed will more perfectly fit the space left when proper inversion of the foot is obtained. Following this, the foot should be inverted and placed in plaster of Paris for three or four weeks, after which the plaster should be removed and the foot held by spiral strapping. Later a light spring plate is useful to relieve the operated region from strain in weight-bearing. After six or eight weeks, baking and massage will help to increase the circulation and restore the tonicity of the foot. Passive motions should then be encouraged, and the patient given crutches. A good functional result was obtained in the two cases reported below.

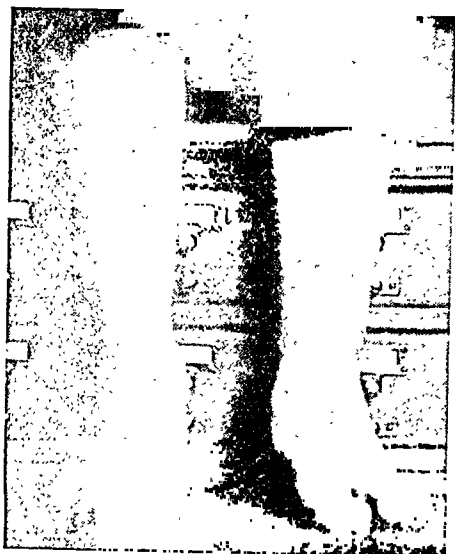
Hoffman calls attention to the rarity of these fractures, and finds only twenty-two reported in the literature. He states that diagnosis can only be positively made by the use of the radiograph. He recommends plaster dressing in acute cases and operative interference in obstinate and deformed cases, thereby leaving the periosteum to develop new bone. In the severe cases, with arthritic changes, he excised the whole scaphoid.

FIG. 1.



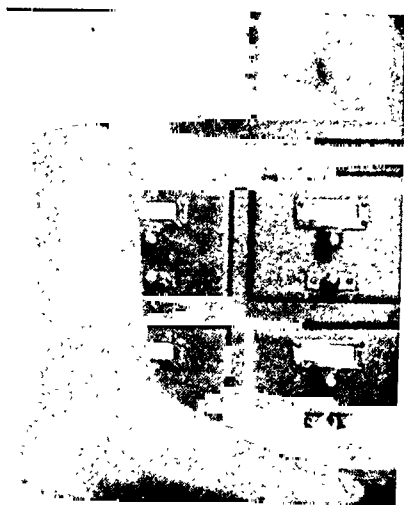
R. M. Fracture of tarsal scaphoid with dislocation of fragment. Taken before operation.

FIG. 2.



W. F. Note prominence over scaphoid and swelling.

FIG. 3.



W. F. Lateral view—swelling obliterating posterior arch.

FIG. 4.



W. F. Fracture of tarsal scaphoid with dislocation of fragment. Taken before operation.

FIG. 5.



W. P. Anteroposterior view of C. 1-2. Taken before operation.

Deutchlander states that conservative treatment is useless. This experience is corroborated by Bahr, who has excised one scaphoid *in toto*, and the displaced fragment in one other. Deutchlander's results in two cases have been good.

CASE I.—R. M., age sixteen. Patient entered the Orthopaedic Department of the Carney Hospital March 2, 1909, and gave the following history:

Family History.—Negative.

Present Illness.—Six months ago fell from a door-step and at that time seemingly injured the right ankle only. Left ankle was lame but did not cause any great amount of inconvenience. Two months after, patient turned left ankle and has had pain in the region of the inner side of scaphoid ever since. Condition has gradually grown worse.

Physical Examination.—Left foot held slightly in a position of eversion and a prominence noted on the inner side of scaphoid. Ankle-joint motions were good. Inversion and eversion at the midtarsal joint, especially the former, limited. Tenderness over prominence corresponding to inner head of scaphoid. X-ray taken (see radiogram, Fig. 1). Diagnosis: fracture of tarsal scaphoid. Referred to House.

March 3, 1909: Ether; operation. An incision about three inches long was made parallel to the dorsum of the foot (*lt*), and over the inner side of the scaphoid. Fascia and periosteum were divided and separated from the scaphoid. The scaphoid bone was soft and there apparently was no attempt made at repair. Owing to inability to correct the foot in inversion the scaphoid *in toto* was excised.

A correct position was possible following this procedure. Chromic catgut was used to sew fascia and periosteum together, while the assistant so held the foot in inversion as to practically obliterate the cavity previously occupied by the scaphoid. The skin was closed with catgut and the foot placed in a light plaster cast in marked inversion. Good ether recovery and uneventful convalescence. March 8, 1909, discharged from House.

Subsequent treatment was removal of cast in four weeks, followed by spiral strapping and a light spring plate to support the longitudinal arch until the musculature was redeveloped. When patient was last seen functional result was excellent. Since then, has been lost sight of.

CASE II.—W. F., thirty-nine years, single.

Family History.—Negative.

Personal History.—Negative.

Present Illness.—Five months ago fell 22 feet from a scaffold, landing mostly on left foot. Has had pain in ankle and used crutches to walk since the accident. Had strapping and bandaging without relief.

Physical Examination.—Left ankle prominent and enlarged over scaphoid. Ankle-joint motions limited only in extremes. Midtarsal joint motions markedly restricted and accompanied by pain referred to region of scaphoid. Considerable muscle spasm and rigidity. Foot in position of valgus, which cannot be corrected. Considerable thickening around the scaphoid. Photographs taken (see photographs, Figs. 2 and 3); radiogram taken (see radiograms, Figs. 4 and 5). Diagnosis: fracture of tarsal scaphoid. Referred to House.

June 9, 1909: Ether; operation. A semicircular incision made and the same technic followed as in the above case. Only the fractured portion of the scaphoid bone was removed. No attempt at union could be seen. Wound was closed in usual manner, and foot put up in an inverted position. Uneventful convalescence. Removal of plaster cast in four weeks. Strapping and plate used. Baking and massage were useful in attaining better circulation and function. Result: a good functional foot.

CONCLUSION.—Fracture of the tarsal scaphoid, although rare, may occur without fracture of other tarsal bones. In both cases swelling and tenderness existed over the scaphoid. Ankle-joint motions were normal, but a marked limitation in inversion was present and in abduction at the mediotarsal joint. Correction could not be attained by manipulation.

The scaphoid in structure was found in both cases to be a good deal like the softening occurring in old ununited intracapsular fractures of the head of the femur.

Excision of the scaphoid seems justifiable and remarkable, in that the static condition of the foot is not weakened but markedly improved in the two reported cases by this procedure. In new cases where the injury has just occurred.

the deformity occurring would suggest the foot being put in plaster in a marked varus position.

Lange, of Cincinnati, covers some of the methods of recognizing such fractures, and believes them to be more numerous since the use of radiography.

Nippold calls attention to errors in diagnosis on account of accessory sesamoids.

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CHARLES ROBERT BELL KEETLEY, F.R.C.S.

MR. CHARLES R. B. KEETLEY died at Brighton, England, on December 4, 1909, of heart failure, in the sixty-second year of his age. It is especially proper that the ANNALS OF SURGERY should record an appreciation of the character and work of Mr. Keetley, who was one of the founders of the Journal, and who during the earlier years of its history was a very frequent contributor to its pages, and who during his whole subsequent life remained its warmly interested friend. The first paper in the first issue of the ANNALS OF SURGERY was from the pen of Mr. Keetley. The title was "On Removal by Scraping out of the Marrow of Long Bones, and Especially on this Proceeding as a Treatment of Osteomyelitis." This paper displayed in a marked manner the peculiar characteristics of Mr. Keetley's mind,—his avidity for new truths, his readiness to accept and act upon the experience of others, and his own ingenuity and resourcefulness in the working out of new ideas. In this article Mr. Keetley struck the keynote which has characterized the ANNALS OF SURGERY throughout its entire history. Of the very elaborate Review of the Surgical Year which was published as an editorial article in the same number of the ANNALS OF SURGERY, Mr. Keetley contributed that portion of it devoted to British surgery. Mr. Keetley took a warm interest in the organization of that department of the Journal known as the "Index of Surgical Progress," and succeeded in enlisting the co-operation of a large number of his colleagues in this department, so that among the list of contributors to that first volume appear the names of Ball and Thomas of Dublin, Cathcart of Edinburgh, Chavasse and May of Birmingham, Wherry of Cambridge, Street of Westgate, and Clark, Dunn, Edwards, Eve, Fenwick, Gould, Hutchinson, McNamara, Pye, Schacht, and Weiss of London. At the special invitation of the writer Mr. Keetley contributed to the special number which concluded the fiftieth volume of the ANNALS OF SURGERY the article which concluded the issue, so that of the first fifty volumes of this Journal the first and the last of the original

memoirs which appeared in its pages were contributed by this one surgeon. The final contribution of Mr. Keetley did not appear until after the death of its lamented author.

The first acquaintance of the writer with Mr. Keetley was made in 1878 in the out-patient department of St. Bartholomew's Hospital. The acquaintance then made soon ripened into a friendship which lasted during more than thirty years, until his death. It was during an after-dinner talk in London, in the spring of 1884, that the idea of a surgical journal which should comprehensively represent both British and American surgical work was discussed between us, and, as I have already mentioned, in an historical note previously published, when upon my return to New York shortly thereafter, Mr. Chambers of St. Louis approached me with a proposition for the editing of such a journal, I at once turned to Mr. Keetley for collaboration. This he gave heartily and without stint, and it has always been a great pleasure to acknowledge the indebtedness which is due from the *ANNALS OF SURGERY* to him for the assistance which he gave in its foundation.

Mr. Keetley was born on September 13, 1848, at Grimsby, being the son of Mr. Robert Keetley, a ship-builder of that place. He began his professional education in the Hull Infirmary, and later entered as a student at Saint Bartholomew's Hospital. As a student he received gold medals at the London University in anatomy and materia medica. After qualifying in 1873 he became house surgeon at the Queens Hospital, Birmingham. In 1876 he took the fellowship of the Royal College of Surgeons of England, and having settled in London was for some years thereafter an assistant demonstrator of anatomy at Saint Bartholomew's Hospital. In 1879 he was appointed assistant surgeon for the West London Hospital, and Mr. Stephen Paget in the course of an obituary notice published in the *Lancet* says of him:

"The true beginning of his surgical career came when he was appointed assistant surgeon to the West London Hospital. It is not too much to say that no hospital ever had a more zealous and faithful servant. From the day he first entered there to the time of his last illness he gave his mind and his strength, even with a sort of extravagance, to its advancement

and welfare. During his thirty years of service the West London Hospital grew from a suburban venture to a great general hospital for a million people, to which is affiliated a great post-graduate school. Keetley's name will ever be associated with this development of the place that he loved. There is little doubt that he could have lived longer if he could have been persuaded to allow himself more rest. He was far more careful of other people's wants than of his own, and his high place in our profession would have stood even higher if he had been more businesslike in his private practice."

In the same article Mr. Paget compares Mr. Keetley with John Hunter in these words:

"Both men alike were thoroughly methodical in the actual practice of surgery at the bedside or in the operative theatre, but were inclined to be neglectful of their own advantage and well-earned payment for their work. They were men of the self-same temperament, of singular tenacity of purpose and force of will, able to go forward over all kinds of obstacles, and in the end to be successful. Each of them also was emotional, readily moved, either to anger or pity or to generosity."

In the course of an appreciative note to the *British Medical Journal*, Mr. Swinford Edwards, a personal friend and colleague of Mr. Keetley for thirty years, says:

"I should say that Keetley's chief characteristics were his honesty, single mindedness, and generosity. He was a man of great energy, dogged determination, and much resourcefulness in operations. Initiative was another of his strong points, as witness the founding by him of the West London Medical and Chirurgical Society, which is one of the largest and best attended societies in London; the Ladies' Association in connection with the hospital; and the Lincolnshire Society, which I believe largely owes its being to his exertions. The same may also be said of the West London Post-Graduate College, which has proved such a success. He was a recognized authority on orthopædics, and the results of many of his cases of plastic surgery were brilliant. His recent works on appendicostomy and on the preservation of the appendix have attracted much notice. We of the West London shall miss him as a real friend, to whom we could turn for help in



C. B. Hedges

any difficulty, and we shall always remember him in his lighter moments for his very humorous and witty afterdinner speeches, and for his great talent as a pen and ink caricaturist. He was a Fellow of the Medical Society of London and of the Royal Society of Medicine, a corresponding member of the American Orthopædic Society, a member of the Harveian Society, and vice-president of the Balneological and Climatologic Society. He was the author of "An Index of Surgery," which was widely read by students preparing for examination as well as by practitioners, and of which the fourth edition appeared in 1887. He wrote also "The Students' Guide to the Medical Profession," second edition 1885, "Orthopædic Surgery," 1900, and "Complicated Fractures," 1902. He contributed many valuable papers to the medical journals, chiefly upon orthopædic, abdominal, and plastic surgery. He initiated the Army Medical Civilian Reserve, the first unit of which went through a course at the West London Post-Graduate College. His scheme was subsequently merged in the territorial force; Keetley, together with Dr. Fowler, Mr. Godlee, and Sir Thomas Barlow, was appointed a lieutenant-colonel, available on mobilization, in the Third London General Hospital territorial force."

Mr. Rickard Lloyd, in a contribution to the *Lancet*, says:

"Keetley always engaged in his work from a love of the science and a determination to practice it as skilfully and successfully as surgical records showed possible, and to improve upon these records if he could. The courage, thoroughness, ingenuity, and resource which he always displayed were especially shown in the 80's and 90's, when operations were increasing in magnitude and variety almost every day. He was one of the first to adopt Listerian methods, and in his operations he always from the beginning of his hospital career insisted upon thoroughness in antiseptic preparations and precautions. Although so bold a surgeon, he was a very careful one. He allowed as little blood as possible to be lost, and he liked his patients to have the minimum of the anæsthetic administered, preferring ether to chloroform. The results of his operative work were extraordinarily good.

"Keetley's social talents were great, despite his infirmity

of deafness. He was exceedingly interesting, original, and generally amusing in his speeches, and a very clever artist. I have seen him illustrate his surgical work scores of times with clever drawings, which he made with amazing rapidity and exactness. I have seen many humorous and caricature drawings that he has made when out of the range of some speaker—and unfortunately deafness, his great misfortune in life, often placed him there.”

Mr. Keetley was of good physique and splendid muscular development. The accompanying portrait shows well his personal characteristics. The firm mouth and chin, the finely cut and large nose, and the twinkling eyes suggest the mingling of energy and tenacity and humor which were his essential characteristics. During his student days he was a keen athlete, and was well known as a good foot-ball player, oarsman, and boxer. It is more than probable that at this period he injured his heart, for the existence of the cardiac defect to which he ultimately succumbed was known to him for many years, although his most intimate friends were unaware of it. The last occasion on which the writer had the privilege of seeing Mr. Keetley was in October, 1908. At this time there was no indication that there was any abating of his natural force. An afternoon spent with him at the West London Hospital was full of interest, and the probabilities of a continuance of his surgical activity and great professional usefulness for many years were marked. His response the following year to a request to contribute to the Fest-number, closing the fiftieth volume of the *ANNALS OF SURGERY*, was cordial and immediate. The news of his sudden death was therefore unexpected, and brought to the writer profound grief.

To Charles B. Keetley,—as a surgeon, skilful, progressive, and bold; as a man wide in his interests, generous, self-sacrificing, and tenacious; as an administrator, broad-minded, sagacious, and planning for the future as well as the present; as a scientist, restless, earnest, and open-minded,—the friend of many years, and a sympathetic and laborious colleague in many labors, the writer now pays this final tribute of affection and respect.

LEWIS S. PILCHER.

TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY.

Stated Meeting, October 12, 1910.

The President, DR. ELLSWORTH ELIOT, JR., in the Chair.

RESECTION OF RECTUM BY COMBINED METHOD IN TWO STAGES: FIRST STAGE UNDER SPINAL ANÆSTHESIA.

DR. WILLIAM C. LUSK read a paper with this title, for which see page 836.

DR. HOWARD LILIENTHAL, after examining the case shown by Dr. Lusk, said the line of union between the mucous edges of the gut was absolutely perfect, and both the patient and Dr. Lusk were to be congratulated upon the result. The case was an excellent example of what could be accomplished in these very difficult cases. It must be recognized, Dr. Lilienthal said, that carcinoma in this region, especially adenocarcinoma, is comparatively non-malignant, so that the patient's chances of recovery were good. The speaker recalled one case of adenocarcinoma of the large intestine at the hepatic flexure which he operated on twelve years ago, and eleven years elapsed before the patient returned with a carcinoma of the rectum, which was of an entirely different type than the original growth. This was also removed, but the patient had since died.

Dr. Lilienthal said he approved of the two-stage operation in cases like the one shown by Dr. Lusk, and he believed that it contributed largely to the patient's recovery.

TOTAL LARYNGECTOMY FOR EPITHELIOMA: LOCAL ANÆSTHESIA.

DR. ALFRED S. TAYLOR presented a man, 49 years old, who came to the Fordham Hospital in May, 1910, with the diagnosis of epithelioma of the larynx. The growth had developed to such a size that he was unable to breathe excepting in the upright

position, and he also had some difficulty in swallowing. He had lost much weight, and was exceedingly thin and cyanotic.

On account of the location and extent of the growth and the patient's generally unfavorable condition, a general anæsthetic was deemed inadvisable, and it was determined to do a laryngectomy in two stages, first separating the trachea from the larynx, and then, after a week's interval, completing the extirpation of the larynx.

The first stage of the operation was done on May 20, 1910, the following local method of anæsthetizing the parts being employed: With a needle, a 4 per cent. solution of cocaine was injected into the sensory branches of the cervical plexus on both sides of the neck at the middle of the posterior border of the sternomastoid muscles. Dr. Taylor said that prior to attempting this, he had made a large number of dissections on the cadaver, which had convinced him that by injection he could get the cocaine into those nerves either directly or by diffusion. This proved to be the case, as the local anæsthesia was entirely satisfactory.

A sufficiently large incision was then made upward from the episternal notch, through which the upper end of the trachea was dissected out and divided transversely and sutured to the skin with heavy silk sutures. As soon as the trachea was separated from the larynx, a considerable quantity of thick mucus was coughed up, which relieved the patient a good deal.

A week later, under cocaine anæsthesia injected into the sensory branches of the cervical plexus as before, the laryngectomy was completed. The anæsthesia during this operation, as during the primary operation, was very satisfactory, and there was practically no pain excepting when working in the neighborhood of the laryngeal nerves. In addition to the larynx itself, a considerable amount of the mucous membrane posterior to the larynx was removed in order to go wide of the disease. A tube was then inserted through the nostril, and the mucous membranes sutured around it with chromic catgut. The patient got along well for five or six days; then these sutures through the mucous membrane gave way, resulting in a fistulous tract, and the foot of the bed had to be elevated to save the patient from drowning in his own secretions.

In order to catch the very free secretion from the wound, a

small pouch was formed over the opening of the trachea by a plastic operation, and through this the patient was able to feed himself through a tube which he passed down into the œsophagus. Just before he left the hospital, he was able to swallow water for the first time with very slight leakage through the fistula. When he returned, about two weeks later, it was found that a stenosis had formed at the pharyngeal scar, so that he was unable to swallow or even introduce the tube into the œsophagus. On August 20, 1910, the patient was etherized through the tracheal tube, and the old scar was dissected out. The upper end of the œsophagus was then separated from the lower end of the pharynx and sutured to the skin, so as to give a free opening for the use of the stomach tube. Since that time the patient had been comfortable and was able to feed himself with the aid of a stomach tube, which he introduced through the opening in the neck.

DR. JOHN F. ERDMANN said the method of anæsthesia employed in the case shown by Dr. Taylor was most interesting and absolutely new to him. The opening made in the œsophagus was also a novel method of procedure. In his own series of cases of complete laryngectomy, numbering perhaps six or seven, a stenosis of the œsophagus and pharynx developed in one instance, necessitating a gastrostomy.

DR. ELLSWORTH ELIOT said that in some of these cases there was a possibility of carcinomatous deposits in the lower part of the œsophagus, and under those conditions a gastrostomy was preferable to an opening higher up. In one case that came under his observation, an œsophagotomy was done, but on attempting to pass a catheter, an impermeable stricture was found lower down; this proved to be carcinomatous, and a gastrostomy had to be done.

DR. A. V. MOSHCOWITZ said he had done a number of cases of total extirpation of the larynx under local anæsthesia, although not by the method described by Dr. Taylor. He thought local anæsthesia was preferable to a general anæsthetic on account of the danger of post-operative pneumonia. In one of his cases, the operation lasted over three hours, and another almost three hours; but in spite of this long duration, the patients are better off than after a short operation with general anæsthesia.

DR. HOWARD LILIENTHAL said that in any case of extirpation

that he might be called upon to do in the future, he would be inclined to try the intratracheal method of anæsthesia through the tracheal wound. This possessed the advantage of rendering the patient unconscious, and it also avoided the danger of pneumonia, at least to a much greater extent than by the ordinary inhalation method, as by the intratracheal method any secretions would be blown out. Unless it could be demonstrated that the œsophagus was permeable, Dr. Lilienthal said he would regard a gastrostomy safer than an opening higher up.

DR. TAYLOR, in closing, said that in his case there was no obstruction of the lower œsophagus whatever, and the tube could be passed without any trouble.

Dr. Taylor said that by injecting the cocaine into the sensory branches of the cervical plexus as he had described, the entire anterior aspect of the neck was anæsthetized. These nerves supply the sensory branches to this region. One decided advantage of this method over the local injection of cocaine was that it did not give rise to an œdematous condition of the tissues upon which it was necessary to operate. Very little cocaine was necessary, and the anæsthesia it gave rise to was entirely satisfactory. The method was described about a year ago by one of the men connected with the Johns Hopkins Hospital.

RUPTURE OF THE LIVER FOLLOWED BY SUBPHRENIC ABSCESS.

DR. BURTON J. LEE presented a boy of thirteen from the service of Dr. John Rogers at Bellevue Hospital, who gave the following history: About half-past two in the afternoon, while watching a ball game, he was struck on the right side of the thorax, low down, by a bat, which had slipped from the batter's hands as he was attempting to hit the ball. The distance between the latter and the lad was about ten feet. The patient suffered severe and sudden pain in the region named, was almost breathless for an instant, and then felt somewhat better, though he remained weak and soon complained of thirst. He walked about three blocks to the hospital.

When the patient was examined by Dr. Stilson, the house surgeon, about an hour and a half after the accident, he showed considerable shock, and was very pale, weak, and thirsty. There were slight rigidity and some tenderness in the upper right

quadrant of the abdomen, but no dulness in either flank, the latter symptom appearing about two hours later. At that time, the rigidity over the upper part of the right rectus was more marked, and tenderness in the same region had increased. A blood examination made about this time showed hæmoglobin, 100 per cent.; red blood cells, 4,896,000; white cells, 30,000, and polymorphonuclears 89 per cent.

An operation was decided upon, and on opening the abdomen through a vertical incision over the upper part of the right rectus, there was a gush of blood, which was controlled by pressing the liver directly against the diaphragm. The superior surface of the liver was then examined, and a Y-shaped rupture about three inches long was found close to the attachment to the diaphragm, the left arm of the Y extending almost to the median line.

As it was impossible to reach the tear in the liver by either cautery or suture, the hemorrhage was controlled by tightly packing gauze into the rent. A large piece of packing was placed below the liver, with the object of forcing that organ up against the diaphragm. The wound was closed in layers, and a large piece of gauze was tightly strapped against the liver over the wound to further push the liver upward.

Two days after the operation the boy's hæmoglobin registered 75 per cent., with 3,432,000 red cells. On the tenth day the blood analysis gave practically the same results, with 16,000 white cells and 80 per cent. of polymorphonuclears. Transfusion by the Elsberg canula was attempted two days after the operation, but was unsuccessful.

Nine days after the operation the gauze drains in the tear in the liver were completely removed, and no oozing followed. Subsequent to this, there was persistent tenderness over the upper abdomen, with accompanying temperature elevation. Two weeks after the original operation, an exploratory operation was done by Dr. Erdmann over the upper left abdomen, but the findings were negative. A week later the right chest gave signs of dulness posteriorly, low down. Three explorations with the needle were made, with negative results. Six weeks after the operation the right chest was opened by Dr. Lee with negative findings. Two days later, Dr. John A. Hartwell, the attending surgeon, obtained pus by needle exploration on the left side below the diaphragm, and later a large cavity was opened and drained.

This cavity, apparently, did not communicate with the right side of the abdomen. From this time the boy went on to complete recovery. He ran a temperature continuously for seven weeks following the original injury. Five weeks after the first operation, his hæmoglobin had dropped to 20 per cent. His abdominal wound on the left side had now entirely healed, and that on the right side over the original site was but a minute sinus about half an inch long. His general condition was excellent.

The interesting features of this case, Dr. Lee said, were: 1. The site of the rupture in the liver, making the use of suture or cautery impossible. 2. The efficiency of packing in controlling hemorrhage from the liver. 3. The long and complicated course of the case, with the final disclosure of the left-sided subphrenic abscess.

THE ANATOMY AND TREATMENT OF UNDESCENDED TESTIS; WITH ESPECIAL REFERENCE TO THE BEVAN OPERATION.

DR. A. V. MOSCHCOWITZ read a paper with the above title, for which see page 821.

In connection with his paper, Dr. Moschcowitz presented a number of patients showing the result of the method of operation described by him.

DR. ROBERT T. MORRIS thought that in the treatment of undescended testis we had little need for any other operation than that devised by Bevan. A few days after the original description of that operation was published, he employed the method on a case and had found that he could lengthen the vas from two to three inches, and since then he had not found it necessary to resort to any other method. By cutting everything excepting the vas and its artery, the vas immediately unravels for three or four inches without any trouble, as a rule, in adults.

Dr. Morris said he was not altogether sure that it was even necessary to spare the artery of the vas, which followed usually very close to the vas and was quite as tortuous as the vas itself, but he recalled two or three cases where there was an anomalous distribution of the artery and where he was not at all sure that the artery was saved, and yet those cases resulted favorably, the lymphatic circulation apparently maintaining the organ until a new blood supply was established.

Dr. Morris said that should the testicle slough, or in cases where the undescended testis was so small that it was scarcely worth while to bring it down, he would remind the members of the Society of Dr. Robert F. Weir's suggestion regarding the psychical and æsthetic value of a celluloid substitute. The speaker said he had resorted to this procedure in a number of instances, chiefly after the removal of the testis for tuberculosis or as the result of injury. The celluloid substitute for the testis should be immersed in a physiological salt solution just before insertion and after sterilizing it in a 5 per cent. formalin solution. These celluloid substitutes are made to order by the celluloid company in New York after Dr. Weir's models.

DR. HOWARD LILIENTHAL suggested that perhaps the sterilization of the celluloid testis might be dispensed with, as it was already sterile.

DR. JOHN B. WALKER said that in 125 cases of undescended testis upon which he had operated, he did not think that he had employed the Bevan method more than two or three times. He had not found it necessary to divide the vessels. The chief difficulty he had encountered was in the division of the connective tissue.

Dr. Walker said he agreed with Dr. Moschcowitz that the vas was always sufficiently long. He had found that in very young children, when the testis was brought down, the cord gradually lengthened as time went on. In separating the sac from the vas, it was essential to use the greatest care to avoid injuring the parts. As the majority of these operations was done on comparatively young children, generally during the third or fourth year, when the vas was very small, he thought it important that all the vessels should not be divided.

DR. HOWARD LILIENTHAL said he had operated on a number of cases by the Bevan method, and for the most part successfully, but in one instance he was compelled to remove the testis on account of sloughing. That patient was a boy about eight years old, and the operation was very easily performed; the testicle was held in its new position without undue tension, and yet necrosis set in.

DR. WILLIAM A. DOWNES said he had done the Bevan operation as described by Dr. Moschcowitz about twenty times with entire success. In all of his cases it was easy to divide the sac

at the internal ring, and there was no difficulty in saving a sufficient amount of the lower end of sac to form a tunica vaginalis—a step which Dr. Bevan considers very important. Dr. Downes understood from Dr. Bevan that while the dividing of the spermatic artery and veins might be necessary in an exceptional case, that it was not the essential feature of his operation.

Dr. Downes said he had never seen sloughing of the testis in any of his cases. The scrotum usually became ecchymotic, but the swelling disappeared in a few days, and within a few weeks the testis appeared to be in a normal condition. As to the age at which the operation should preferably be done, the speaker said he preferred to operate between the ages of eight and fourteen years rather than earlier.

DR. MOSCHCOWITZ, in closing, said he would not care to operate on these cases earlier than the age of three years; he had operated on children as young as that, and many of the people who brought their children to the hospital were anxious to have the operation done as early as possible. The age at which the operation should preferably be done depended somewhat on the class of patients we had to deal with.

The speaker said that this condition of undescended testis was always complicated by hernia, which could not be taken care of efficiently by any form of truss. In view of the fact that we did not oppose a radical operation for the cure of hernia in a child of three years, he saw no reason why the other condition should not be corrected at the same age. From that time on the operation could be done up to almost any age.

Dr. Moschcowitz said that Dr. Bevan's original article was published in the *Journal of the American Medical Association*, and his more extensive paper in *Langenbeck's Archives*. He had studied the paper very carefully, and thought he understood its purport, as well as its advantages over the Schüller and other operations; if Dr. Bevan did not claim the points he had mentioned as the particular advantages of his method, then he was sorry for it, because he regarded them as of paramount importance.

BOOK REVIEWS.

EPOCH-MAKING CONTRIBUTIONS TO MEDICINE AND SURGERY AND THE ALLIED SCIENCES. Collected by C. N. B. CAMAC, A.B., M.D. With portraits. Philadelphia, W. B. Saunders Company, 1909.

The title-page of this book states that it contains reprints of those communications which conveyed epoch-making observations to the scientific world, together with biographical sketches of the observers. Upon opening its pages we find that under this head the author has included Joseph Lister and his paper on "The Antiseptic Principle of the Practice of Surgery," read at the meeting of the British Medical Association, August 9, 1867; William Harvey and his booklet on "The Motion of the Heart and Blood in Animals," 1628, Willis' translation; Auenbrugger and a translation of his original treatise on "Percussion of the Chest," 1761; Laennec and his treatise on "Diseases of the Chest and Mediate Auscultation," 1818; Jenner and his tracts on "Variolae Vaccinae," 1798 to 1800; Morton, and his remarks on "The Proper Mode of Administering Sulphuric Ether by Inhalation," 1847; Oliver Wendell Holmes, and his paper on "The Contagiousness of Puerperal Fever," 1843. Biographical sketches and lists of the writings of the various authors quoted accompany these papers. Dr. Camac says in his introduction that he has made no effort to present his subjects in chronological order, but his main idea has been to select these epoch-making articles—which he regards as masterpieces of scientific research—from the great mass of valueless or ephemeral writings among which the student must search for them if he desires to find them. The best English translation has been selected for articles which appeared in a foreign tongue. Dr. Camac has done an altogether admirable thing in bringing together these papers and putting them in shape that makes them at once accessible to every one. Naturally, those contributions which present the work of the Anglo-Saxon race have taken first place in the estimation of the

compiler, and one realizes in glancing over the list how large a part in bringing to the use of mankind resources in the healing art of the greatest magnitude the workers of that race have been permitted to play. Lister, Harvey, Jenner, Morton—Antisepsis, The Motion of the Heart and Blood, The Prevention of Small-pox, and the Abolition of Pain during Surgical Procedures—no similar list, in the far-reaching extent of the benefits that these have conferred, can be compiled.

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